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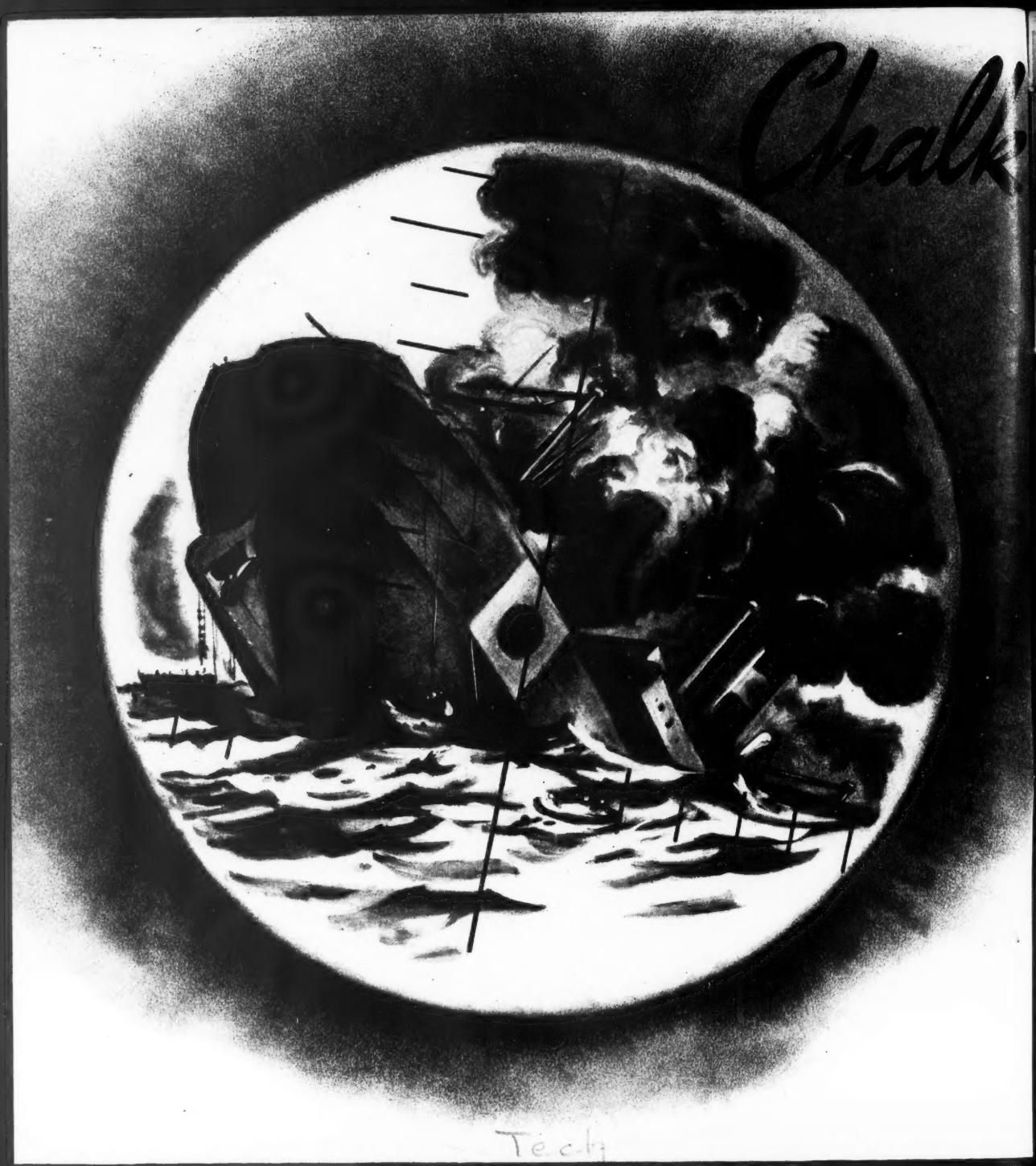

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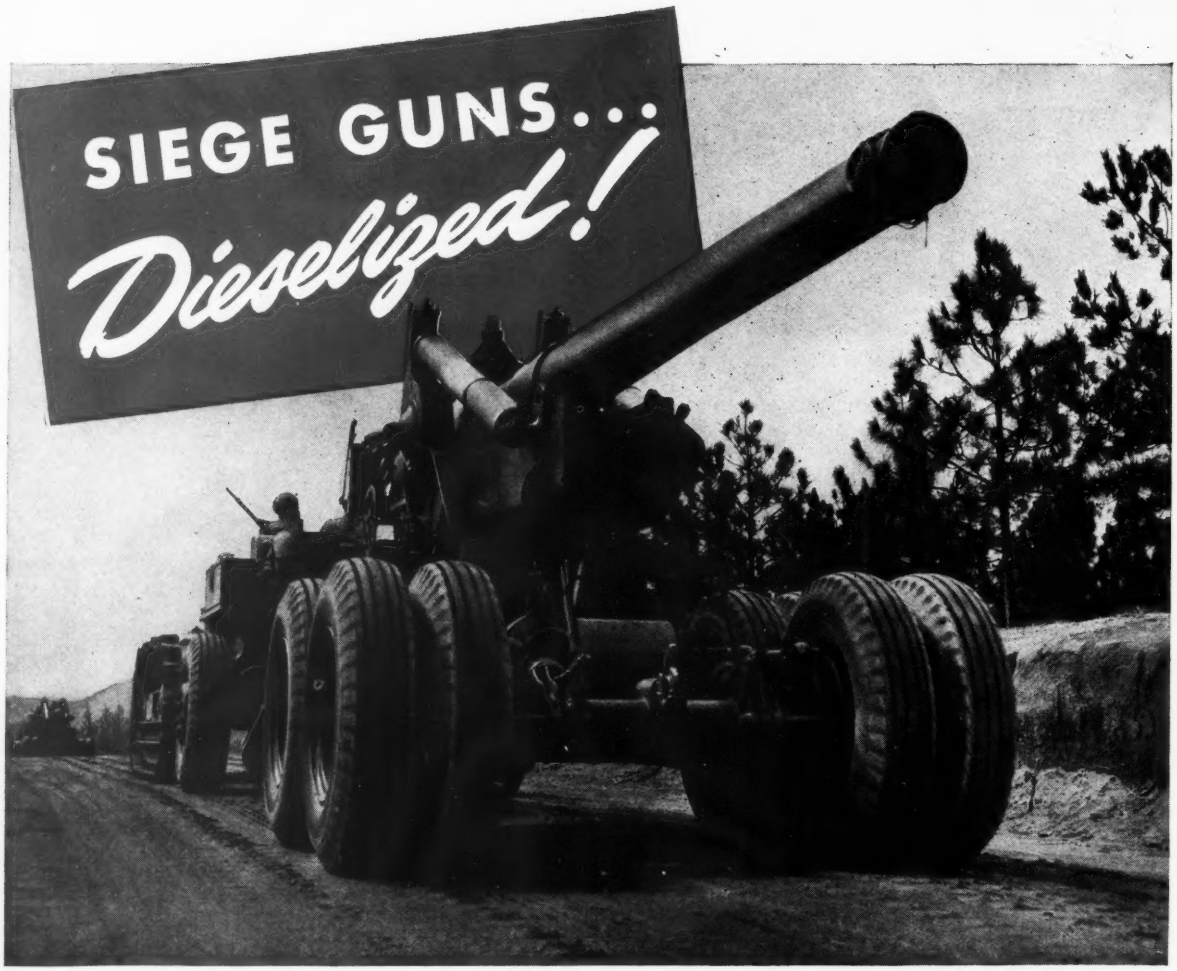

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George E. Andrews

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Contents, July, 1943

VOLUME 47 — NUMBER 7

Front Lines 7

What Leaders Say 49

Headache in Tunis 50

With the Editors 51

The New Diesel Plant at Rushville, Ind. 52
By Glenn C. Boyer

A New Armature Winding Diagram (Part III) 56
By William T. Taylor

Store Coal Now to Meet Coming Production Peak 60
By Chester R. Earle

Turbine Maintenance in Hawaii 63

Conversion from Oil Firing to Coal Firing (Part II) 66
By Ollison Craig

Bomb-Proof Construction of Utilities 69
By Bill Maddock

Chemical Removal of Scale 71
By F. N. Alquist, C. H. Groom and G. F. Williams

Failure of Fusible Plugs 72

Selection and Maintenance of Speed Reducers 73
By Francis A. Westbrook

Keep Them Pumping (Part II) 75
By J. O. Glenn

CMP in Full Operation—What It Means to the Power Engineer 102
By Priority Staff of The Research Institute of America, Inc.

New Transformer's Form-Fit Tank Saves Space 106

ASHVE Summer Meeting 108

Power for the New Geneva Steel Mill 110

More New ASTM Standards Approved 124

New Equipment 130

Obituaries 140

Manufacturers' Personals 142

Manufacturers' News 146

News from the Field 150

Helpful Bulletins 157

New Engineering Books 164

Power Plant Construction News 168

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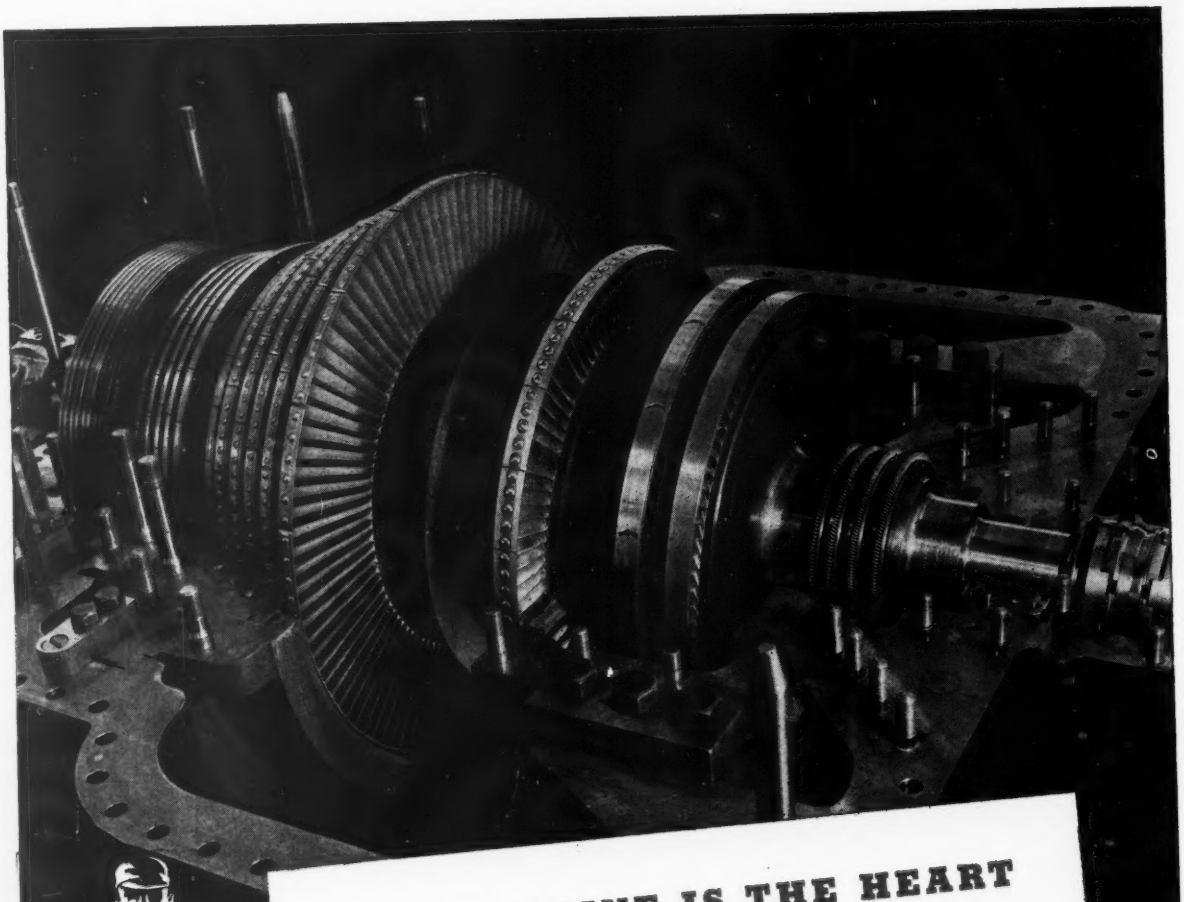

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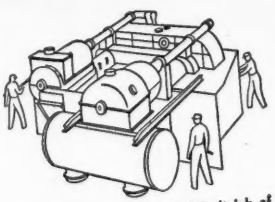
Deep in the hulls of the big cargo ships are humming hearts of steel... bearing the Hendy name-plate. These turbines, developing thousands of horse-power, speed the guns, ammunition and supplies, on dependable schedules, to our multiple battle front.

To build these intricate power plants requires not only vast plant facilities, precise material control, precision tools and fabrication methods, but in addition, a group of highly skilled engineers, master craftsmen and production strategists.

Like the huge 2500 hp Hendy engines, which now power one-third of all Liberty ships, Hendy turbines are the heart of a vital military transport system that some day will be used to reconstruct a war-torn world.



Hendy has reduced the difficult job of building marine steam turbines and their reduction gears to a simple, straight-line production method which assures accuracy and economy with dependable delivery schedules.

Hendy has been awarded the Maritime M and the Army-Navy E...each with an extra Star for continued outstanding production.

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FRONT LINES

WHEN THE SECOND WORLD WAR put an end to the importation of Italian pumice, there was no mad scramble in the United States for substitute sources on this side of the Atlantic. An exceptionally pure variety had already been discovered and developed in the American Southwest, in the Mount Taylor region of New Mexico. Pumice, a mild natural abrasive, has many important industrial uses. It is employed in polishing and finishing wood, rubber, glass, metal, plastic, and painted surfaces; it is a constituent in acoustic plaster, mechanic's soap, and many patented cleaning and polishing compounds, is used as a fluxing agent and for filtering and processing aviation gasoline. A detailed and very interesting article on the mining and preparation of pumice appears in the June, 1943 issue of Compressed Air Magazine.

IRON ORE from North Africa is now arriving at East Coast ports and it is expected that ships will start bringing scrap from that continent this summer. The ore coming in at present is mostly fines picked up as ballast and requiring sintering before being charged to blast furnaces. The cargoes of scrap expected to arrive during the summer may prove of great assistance in providing material for next winter.

ON MANY WPB and OPA orders, standards play an important part either through reference to existing standards or by setting up standards or simplification schedules in the order itself. Such standards form the basis for control of production, conservation of materials or control of prices. A number of orders have the effect of setting up standard specifications, tests, or simplification schedules on such things as fans and blowers, industrial instruments, hand tools, valves and valve parts. A list of these is given in the March issue of Industrial Standardization published by the American Standards Association, 29 West 39th St., New York City.

MOST non-engineers tend to think of steel as our strongest and most useful material, but they haven't seen anything yet—wait until the details of some of the new alloys can be revealed (See page 49, this issue). Engineers, however, are not at all surprised at some of the characteristics of things like natural spider silk and glass. For example, since the use of spider silk for cross-hairs in optical instruments has been dramatized so much, some of its interesting properties have been determined recently. A report in Cenco News Chats says that spider silk has a diameter of 0.0001 in. or less, a density of 2.98 grams per cubic centimeter and about 24 ounces of it would reach around the earth. Tested with a Cenco tensiometer, its ultimate breaking strength was found to be 60,000 psi. It has considerable elasticity but also shows some flow properties. The marvelous use of glass springs is reported by Ohmite News. For many services, glass may be better than steel. It is more truly elastic, retains its elasticity over a wider temperature range and is immune to acids and apparently to fatigue. One glass spring showed no sign of failure after 8,000,000 deflections in a sulfuric acid mist.

FROM 6 to 11 p.m., Monday through Friday, a special night shift of bankers, brokers, attorneys, business executives, salesmen and bookkeepers is helping to produce valves at the Bridgeport, Conn., plant of Jenkins Bros. They work as tool designers, tool makers and on the machine benches. This special shift has turned out to be a huge success, according to Bernard J. Lee, vice president in charge of manufacturing. "Many of these men," he says, "have brothers or sons in our armed forces, and they realize the vital importance of valves in the shipbuilding program. They are motivated by patriotism—a sincere desire to share in the war on the production front." This is one of a number of such instances we have recently learned about. A number of plants in the Chicago area have arrangements of this kind for white-collar workers. We understand, also, that in one of the Eastern shipyards a complete swing-shift welding crew is made up of anthropologists and archaeologists.

FROM THE MIDST of a company of captured Italian troops, marching to our rear after the North African fighting, a voice was heard to say, in perfect American, "What are *you* grinning about, Yank? *We're* going to America; *you're* going to Italy."—Chester Morrison in The Chicago Sun.

TO DETERMINE whether a piece of material or equipment can be used in its present form or put into war production in the form of scrap, the Special Projects Salvage Branch of the Salvage Division, WPB, is publishing bimonthly the "Available Used Material and Equipment Bulletin." This is intended to help in the solution of one of the most puzzling problems in the national salvage program. It is a particularly difficult problem in the power plant field. The power engineer, in maintaining and repairing his power plant equipment, uses a great deal of material that might ordinarily be considered scrap. As we have previously pointed out, the power engineer uses welding a great deal in this work, often has certain machine tools available and fabricates devices, to fit his particular plant and conditions, that could not be made by mass production methods in any case. For that reason, if he is unable to save miscellaneous lengths of pipe, tubing, sheet steel, pieces of old railroad rail, old steel shafting, and other such "junk" for exactly this purpose, his maintenance work may be greatly hampered by the difficulties of finding such things on the open markets, even though he has a very high allocation number under CMP. (See page 102 this issue.) All engineers are familiar with this problem. Therefore the usual arguments for scrapping equipment that apply to a great many fields do not seem to apply here. The power plant engineer wants to help the scrap drive in every way possible, yet he is the one charged with the responsibility of keeping his plant running no matter what happens. He'll do it as long as the supply of baling wire holds out, but if you take away from him even the baling wire without giving him *anything* to work with, not even "junk," his ingenuity is pretty severely taxed.

MEN LIKE W. A. Patterson, president of United Air Lines, cannot afford to kid themselves or anybody else with fantasies about the wonders of the coming air age. Front Lines pointed this out last month. Here is another illustration of Mr. Patterson's realistic attitude. Speaking before the National Industrial Conference Board sometime ago, he pointed out that the cost of moving 1560 tons of freight from Chicago to San Francisco by train would be $50,000, but by plane would be $1,750,000. The fuel item alone would be $200,000 for the planes as against $3400 for the locomotive. A 13,000-ton ship could make the two-month round trip between San Francisco and Brisbane, Australia, carrying 6400 tons of freight each way for $120,000. To do the same job by cargo plane would cost $29,000,000. We all forget that planes are being used today for military reasons because they provide the quickest and frequently the only way to do this work. The money cost of the job cannot be allowed to enter into the calculations now.

WHEN THE AVERAGE architect or house builder talks about low cost housing he usually means a house costing around $8000 or $9000 and not very much of a house at that. Considering that the average income of most of the population of this country for years was below $1800, this writer has always thought that most of this talk about low cost housing was unadulterated schmalz. There seems to be a ray of hope, however, that the building industry may be rescued from the toils of the carpenter's unions and the mortgage holders. What would you say if a number of architects told you that good houses of the most modern design can be built for $3300 and even less? We have before us the design of a basic house, to which extensions can be made from time to time, that can be built for between $1200 and $2000. Naturally, this cannot be done by orthodox methods but the methods by which it can be done are even now in actual use. If you are interested, write to Revere Copper and Brass, Inc., 230 Park Ave., New York, N. Y. They are publishing a series of bulletins on the housing of the future in which, of course, they will naturally participate by supplying various metal products. We think their dissemination of these ideas about housing is an outstanding contribution to the national welfare.

FOR THE FIRST TIME in its history, says WPB, the nation now has a physical plant adequate to make the maximum use of its resources in men, skills and materials. Accordingly the WPB proposes to take two steps. The first involves a reexamination of all previously approved projects for construction of new manufacturing plants and machinery, to determine whether the need for them can be eliminated by a greater use of present structures, plant capacities, machine tools and equipment. The second step calls for no purchase of new machine tools, machinery or equipment, or erection of buildings, until it has been conclusively proved that the work cannot be done by existing facilities. Thus the process of conversion and shifting within the war program, to which we have been referring for several months, actually gets under way. This does not mean that we have reached the peak of our total war production, for we have not. It simply means that now we must make the necessary adjustments to increase our total production far above present levels, if the war plans for this year and next are to be carried out.

THE SANGUINARY struggle between the Nazis and the Russians for control of the Donets Basin is a battle for industrial resources and for coal in particular. Up to the time this region was captured by the Nazis, it accounted for nearly 45 per cent of Russia's total coal output. Germany's primary reason for wanting it was to utilize the coal as the base for producing half its petroleum supplies. Oil experts estimate that Germany produced 46,000,000 bbl of oil from coal last year. This production has increased until it is now more important than natural oil from Rumania. This is the reason why the Germans have not collapsed for lack of fuel oil. Full details of the coal situation in the Donets Basin are given by Gordon Bradley in an article, Diamonds of the Donets, in the April-May issue of The Fusion Point. This is the first and only complete detailed article we have ever seen on this subject. Illustrated with maps and very interesting photographs, it shows the relation of the Donets industries to coal and to the decentralization of industry in Soviet Russia and the coal industry in particular. Here are the cold, hard, engineering facts that underlie all the geo-political shriekings of the Nazi paranoiacs.

"YOU CAN'T ship liquids in a bag," said we blithely in the April issue. Oh, yeah? Just to show how easy it is to stick the neck out and what happens to same, now comes news that a bulk package for shipping malt syrup, consisting of a Vinylite, resin-coated, heat-sealed cloth bag in a corrugated-cardboard carton has been developed by the Gordon-Lacey Chemical Products Co. for Standard Brands, Inc. This bag is also recommended for shipping other water-base liquids and oils. The bag is slightly larger than the outer carton to avoid straining the seams and the package is resilient enough to withstand sharp blows. In severe drop tests, after 500 drops the cartons were damaged but the inner bag remained intact. So we were wrong. Well, this is still a free country, where every man has a perfect right to make a damn fool of himself if he chooses.

AMERICA'S steel industry put into operation nearly 1,100,000 net tons of new steelmaking capacity and more than 3,100,000 tons of new blast furnace capacity during the last half of 1942. As a result, the annual steelmaking capacity of the nation has increased to a total of 90,292,660 tons of steel ingots and castings as of January 1, 1943. Blast furnace capacity rose to 63,933,530 tons of pig iron and ferro-alloys per year. Present capacity of the industry is probably more than half of the entire steel capacity of the world. Still more new steelmaking capacity is in an advanced stage of construction and upon completion will raise the total capacity to approximately 96,000,000 tons of steel a year.

WARNING that a new crop of trained saboteurs from the Axis countries will try to enter the United States in the near future, the Federal Bureau of Investigation asks all citizens to cooperate with it in guarding America's war effort. In war production plants especially, vigilance is more necessary than ever. The FBI states that citizens should not hesitate to report any facts they think should be reported, even though they themselves may not consider them very important. The FBI may think so. The FBI guarantees that citizens reporting such facts will not be "wasting the time of important men" and that whatever they disclose to the FBI will remain completely confidential.

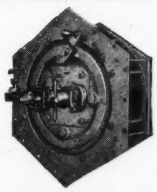
No. 3 in a series of tributes to America's War Industries

What's more— THEY CAN DISH IT OUT!

A Jap naval squadron is finally brought to bay. Like a trapped animal, it fights back ferociously . . . sends a storm of shell-fire thundering through the night. Many miss, some hit . . . and hurt. But the American warships shrug off the blows . . . hurl back five for everyone they take. Another big slice is blasted out of the Nipponese Navy and securely tucked away—in Davy Jones' locker.

Our fighting ships are champions born of America's industrial genius. Broad-shouldered battleships, compact cruisers, lithe destroyers . . . they're the best designed, best constructed, best equipped sea battlers afloat.

As the brains and brawn of American industry launch ships day in and day out, our seven-ocean navy becomes a fighting reality years ahead of schedule. And the smashing of every bottle of champagne is a toast to those enemy ships that still infest the seas. "Bottoms up!"



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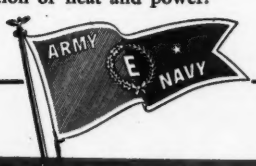

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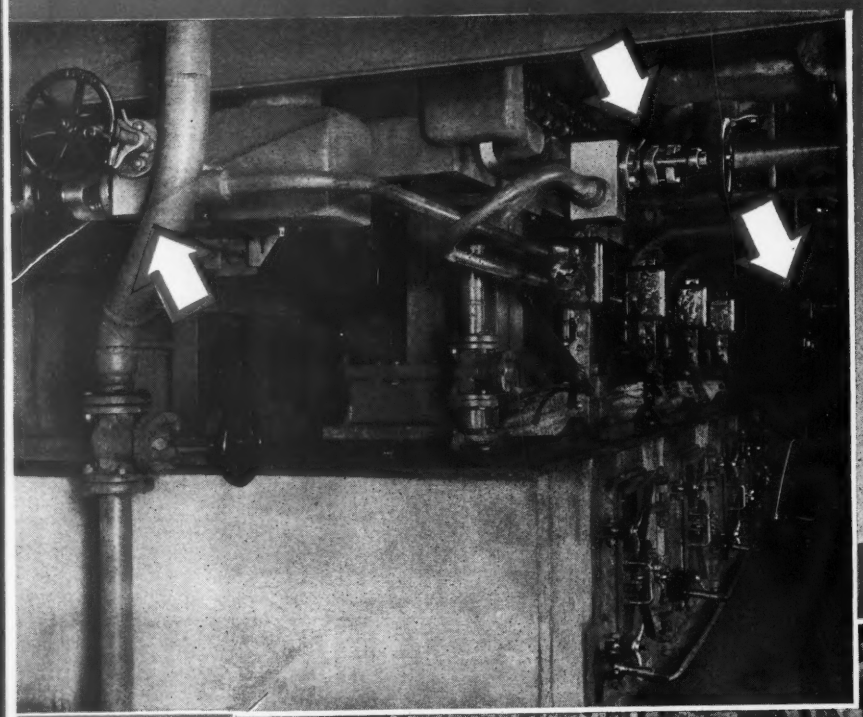
YARWAY



Above: Yarway Unit Tandems on Water Wall Drains at West Reading Station of the Metropolitan Edison Co. There are 4 sets of these Tandems used—two sets on each of the two Boilers in the New Addition to this plant. These valves are used to drain the water walls only when the installation is periodically shut down for maintenance.

Below: Two of the four sets of Yarway Unit Tandems on the two new Boilers at West Reading Station. These valves are used to blow down the lower drums about once per week.

YARWAY

at West Reading

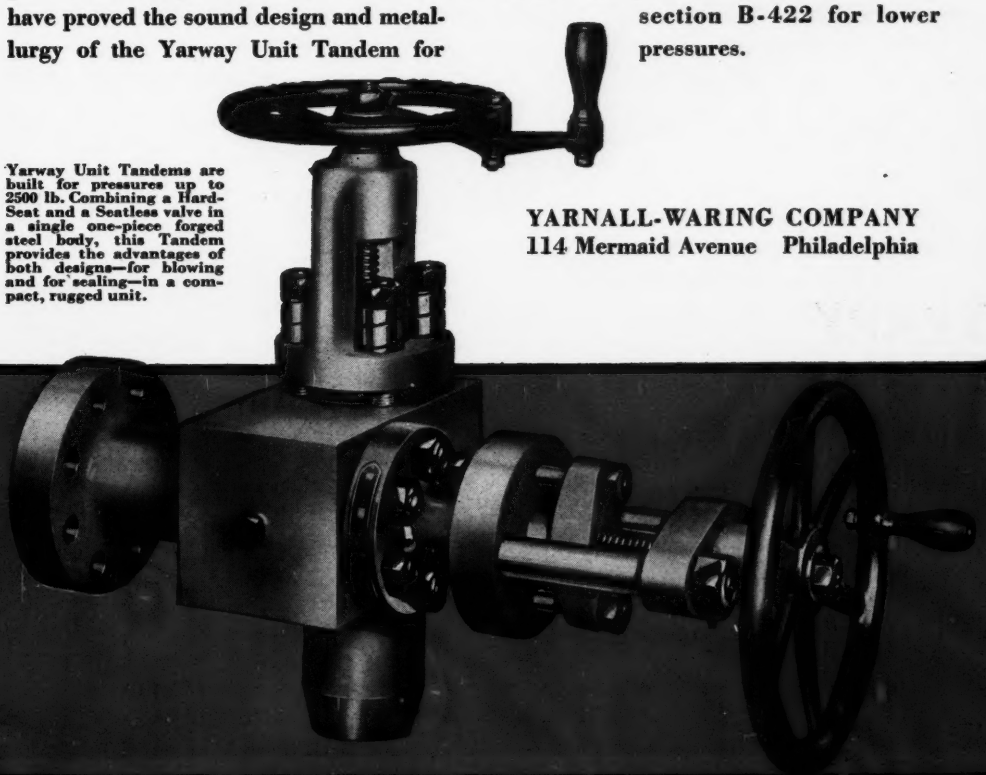
Yarway Unit Tandem Blow-Off Valves Serve this 1400 lb, 900° Station Addition

ANOTHER in the long list of modern high pressure generating stations to select Yarway Unit Tandems for both water wall drains and boiler blowdown lines—the West Reading Station of the Metropolitan Edison Company. (Designing Engineers, Gilbert Engineering Co., Reading, Pa.)

Years of service in the highest pressure plants of leading utilities and industrials have proved the sound design and metallurgy of the Yarway Unit Tandem for blowing down or draining and sealing.

Such records as—"3000 blows at pressures of more than 1300 psi without a single replacement of parts or repairs of any nature"—have made this tandem the outstanding preference for high pressure blow off and draining service, today.

What are your draining and blowdown requirements? Write for Catalog. Section B-431 for pressures up to 2500 lb; section B-422 for lower pressures.



Yarway Unit Tandems are built for pressures up to 2500 lb. Combining a Hard-Seat and a Seatless valve in a single one-piece forged steel body, this Tandem provides the advantages of both designs—for blowing and for sealing—in a compact, rugged unit.

YARNALL-WARING COMPANY
114 Mermaid Avenue Philadelphia

BLOW-OFF VALVES

The TERRY

TERRY
SOLID WHEEL TURBINE
ADVANTAGES . . .

— The blades and the wheel (see above) are in one piece so that there are no parts to become loose or work out.

— The blades have large clearances.

— The blades are double rim protected.

— End play will not damage the blading.

— It is impossible for the blades to foul.

— The power producing action of the steam in the wheel takes place on the curved surfaces at the back of the buckets and, therefore, close blade clearance is not necessary.

— As the only function of the blades is to form a series of pockets, wear of the blade edges is of little consequence and does not materially affect the horsepower or efficiency. The important part of the bucket is the back, or bottom, which is a solid forging.

— The Terry wheel will withstand abuse that would wreck any built up wheel.

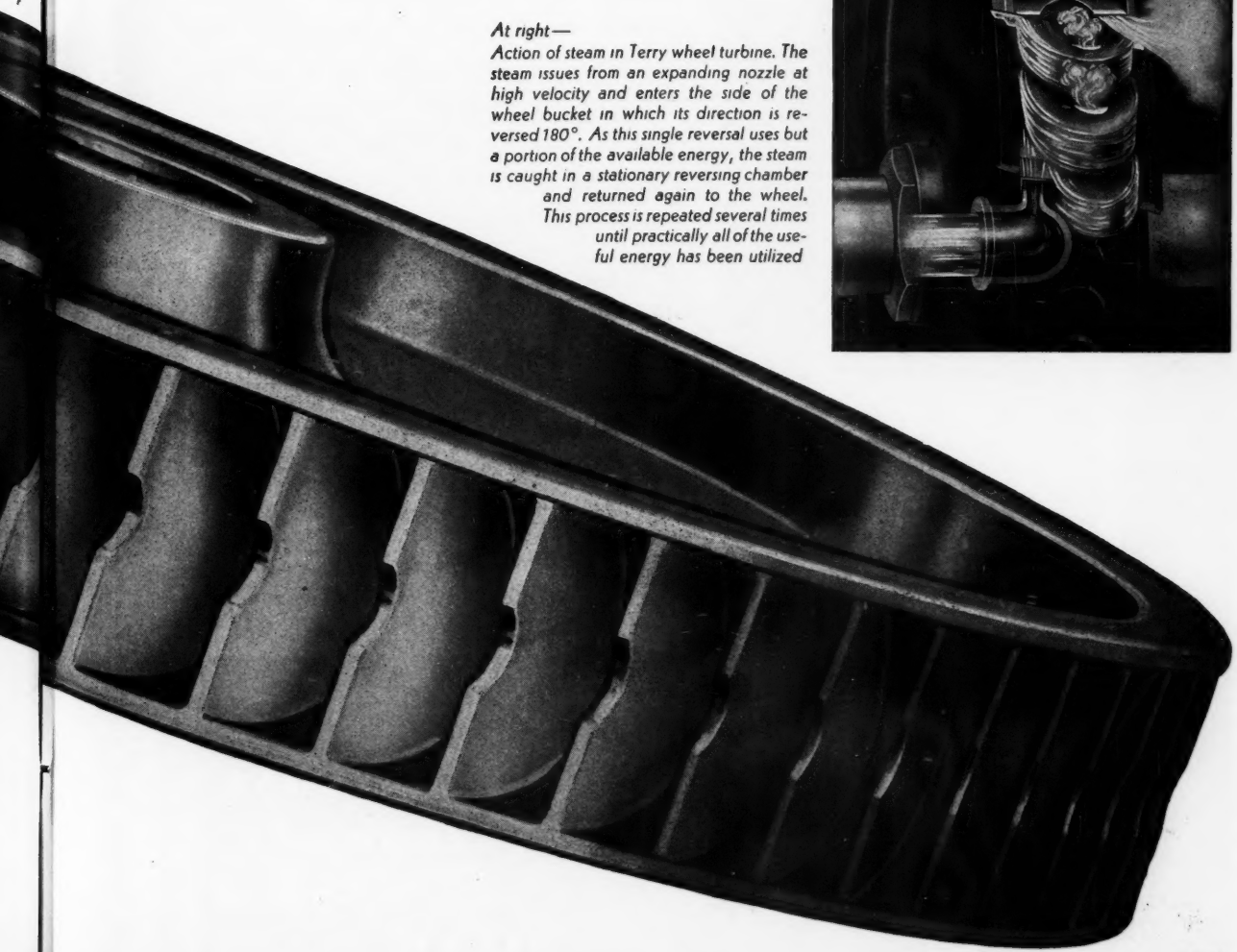
THE TERRY STEAM TURBINE CO.

Wheel Turbine

The Terry Solid Wheel Turbine is available in ratings from 5 HP to 2000 HP. It is built for all commercial steam pressures and exhaust pressures. Thousands of them are in daily service in central stations, industrial plants and on board naval vessels.

Full details of the Terry Solid Wheel Turbine will be gladly sent upon request. Ask for Bulletin S-116.

At right—
Action of steam in Terry wheel turbine. The steam issues from an expanding nozzle at high velocity and enters the side of the wheel bucket in which its direction is reversed 180°. As this single reversal uses but a portion of the available energy, the steam is caught in a stationary reversing chamber and returned again to the wheel. This process is repeated several times until practically all of the useful energy has been utilized



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TERRY SQUARE - HARTFORD, CONN.

Armstrong Traps mean Quicker Heating

. . and "quicker heating" speeds War Production

ARMSTRONG *"Blast Type"* STEAM TRAPS for *Handling Excessive Amounts of Air*

ARMSTRONG Blast Traps are equipped with an auxiliary air vent which is controlled by a flat disc mounted at the end of a strip of rustless thermostatic bi-metal. When steam is first turned on the auxiliary vent in the top of the bucket is wide open. Air and water blow straight through until steam comes in and causes the bi-metal strip to bend upward, closing the auxiliary vent. Thereafter the trap works the same as a standard Armstrong trap.

WITH Armstrong Traps, condensate is discharged as fast as it forms, and air is eliminated automatically ahead of the condensate. These Armstrong features help to assure quick, even, economical heating so vital in today's production.

Here are additional advantages, too that are available in all sizes of Armstrong traps: ability to handle all ordinary sediment and sludge, and freedom from wire drawing and wear. Write Armstrong for a solution to your trap problems.

ARMSTRONG MACHINE WORKS
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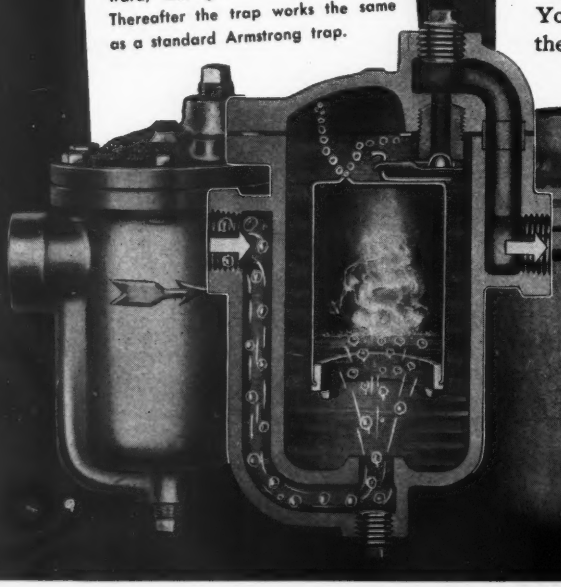
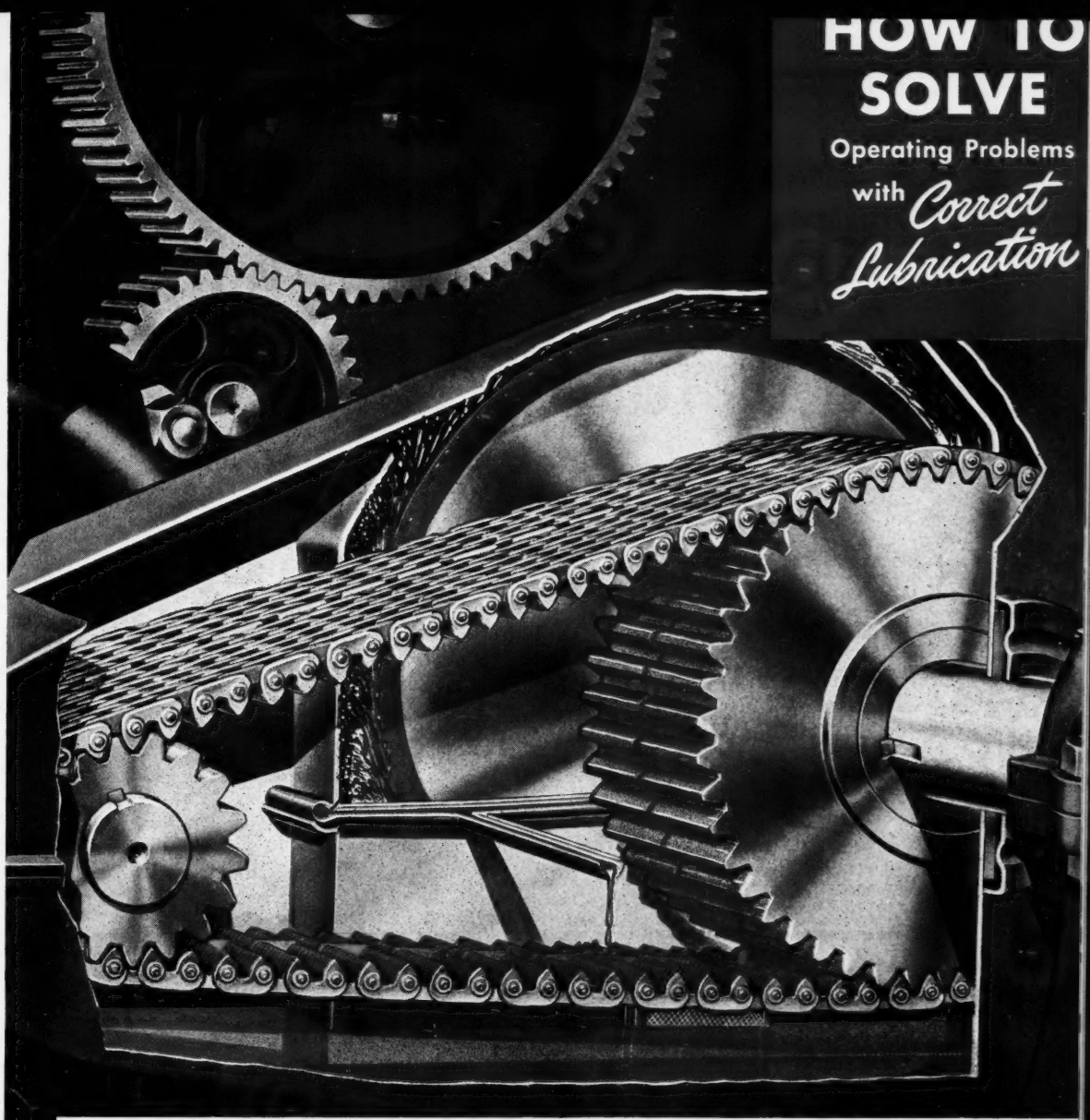
MONTHLY MAINTENANCE TIP

ALWAYS trap steam supply lines ahead of pressure reducing valves, temperature control valves and similar equipment to protect valve and seat from water cutting, minimize possibility of dirt lodging in seat and insure better valve operation. You'll reduce maintenance greatly and increase the life of the valve.



ARMSTRONG *Inverted Bucket* STEAM TRAPS

ONE OF A SERIES OF SUGGESTIONS TO AID PRODUCTION



HOW TO SOLVE Operating Problems with *Correct Lubrication*

Keep this "Chain Gang" Tough!

MODERN CHAIN DRIVES are playing an important part in maintaining wartime production. They have been designed to take heavy loads at high speeds. They'll do their job week after week if given proper service and lubrication.

First, keep your chain drive in proper mechanical condition and correct adjustment, then the next step is... **USE GARGOYLE VACUOLINE OIL** for the type of lubrication shown above. This oil will penetrate the close clearances between the pins and bushings. It will provide a dependable, protective oil film... assure minimum maintenance...maximum oil life. There's the type lubrication you're looking for.

GARGOYLE Lubricants

SOCONY-VACUUM OIL COMPANY, INC. — Standard Oil of N. Y. Div. • White Star Div. • Lubrite Div. • Chicago Div. White Eagle Div. • Wadhams Div. • Magnolia Petroleum Company • General Petroleum Corporation of California

CALL IN SOCONY-VACUUM

TAYLOR STOKERS— naturals for "catch-as-catch-can" coal buying

THE WAR has tossed into your lap the problem of buying coal wherever you can —and burning it. Taylor Stokers have the answer to this problem, as well as others. One mid-west Taylor-Stokered plant reports burning 39 different coals successfully in 1942—16 in a single month! These coals varied from 11,232 B. T. U. to 12,000 B. T. U. per pound as fired. Many were from strip mines.

This company, incidentally has placed repeat orders for Taylor Stokers 12 times and uses both air and water cooled types. One unit, placed in service last year, is illustrated on the opposite page.

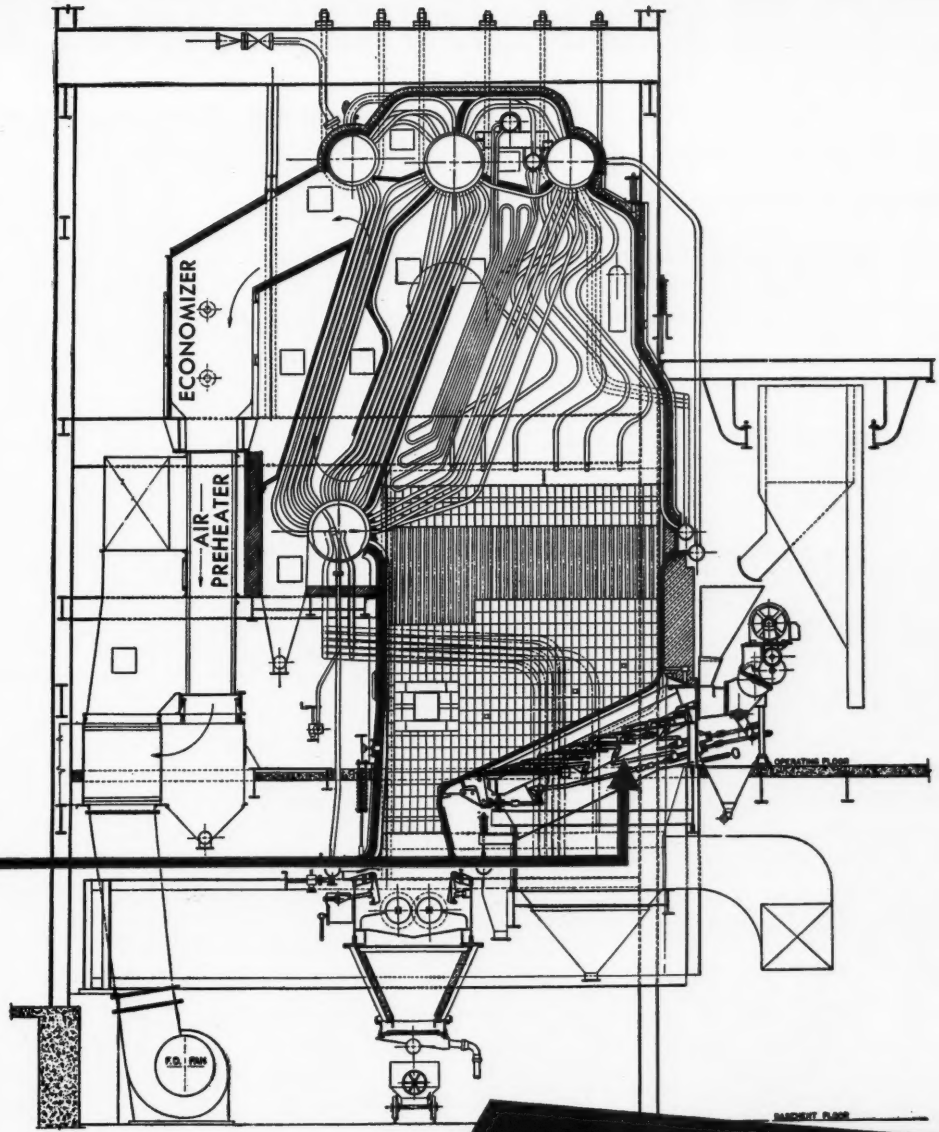
Once again, in war as in peace, Taylor Stoker fuel flexibility pays off handsomely.

JUDGE THE SELECTION OF FUEL FIRING EQUIPMENT BY THESE TWELVE POINTS

1. **RELIABILITY**—the ability to operate with minimum outage and minimum standby equipment.
2. **CAPACITY**—the ability to provide adequate prime capacity ratings, with sufficient reserve capacity for emergencies.
3. **MAINTENANCE**—the ability to operate continuously with minimum repair costs.
4. **FLEXIBILITY**—the ability to follow the steam demand upward or downward . . . quickly and without sacrificing efficiency.
5. **EFFICIENCY**—the proved dollar efficiency (total cost of steam production) as shown by actual performance in similar installations.
6. **OPERATION**—the ability to operate continuously, the number and type of operations required, the ease of combustion adjustments, etc.
7. **ADAPTABILITY**—the ability to meet special and limiting conditions, present and future—structural limitations, utilization of present equipment, growth and change of power service demands.
8. **FUEL FLEXIBILITY**—the ability to burn efficiently and easily fuels from many sources having widely varying characteristics.
9. **REFUSE DISPOSAL**—the ability to economically eliminate ash or refuse and the opportunities of disposal at low cost, no cost, or profit.
10. **STACK DISCHARGE**—the practical elimination of "smoke nuisance" without special equipment.
11. **SPACE REQUIREMENTS**—the ability to conform to existing or future space limitations, to short and wide or long and narrow furnaces. Also the accessibility of component parts for maintenance and operation.
12. **OBSOLESCENCE** — the adaptability of the equipment toward possible future modernization with minimum of complication and outage.

AMERICAN ENGINEERING

PHILADELPHIA • PENNSYLVANIA



A-E-CO TAYLOR STOKERS
LO-HED HOISTS
HELE-SHAW FLUID POWER
MARINE DECK AUXILIARIES

A-E-CO
TAYLOR STOKER

COMPANY

AE CO 75th ANNIVERSARY

DETROIT PUBLIC LIBRARY

Most boiler outages

WATER SAMPLES are accurately checked to see that oil content is being kept to a minimum.

CONDUCTIVITY METER tests to determine the solids in the condensed steam, reveal (1) carry over from the boiler (2) contamination of condensate.

are a needless war waste

PREVENTIVE CARE in action. Samples of boiler water from the nation's vital war plants. Careful periodic analyses by Hall Laboratories, in conjunction with the simplified control analyses made regularly by the plant personnel, assure the proper water treatment to keep these plants in steady operation year after year.

Critical production gives new emphasis to the need for *preventive care*

A BOILER should produce steam efficiently, month in and month out. Unscheduled outages should be rare. Where they are frequent, you can be sure something is wrong. As in the case of human beings, sometimes a boiler requires an operation before it can attain good health; more often, however, all it needs is to be put on the proper diet.

That's where preventive care comes in—doing the things that need to be done . . . and in time . . . so that troubles won't have a chance to develop.

It takes a lot of doing. More than most operators care to undertake alone. Even those whose equipment is the finest and whose plants enjoy the benefit of the most modern laboratories, engage technical help. Hundreds of such plants are Hall clients. They know that preventive care is the safest, surest, most economical way to prevent boiler outages.

From the moment a boiler goes into service, certain factors, unless stopped, go to work to reduce its efficiency. The most serious of these are scale, corrosion, carryover and embrittlement. Thanks to the scientific preventive care pioneered by Hall, they can be controlled. Thereby loss from tube or condenser failure is held at a minimum. A dirty boiler is a sure sign that causative conditions should be diagnosed and remedied.

Your experience with Hall Service would probably be different from any you have ever known. You would have a field engineer on the job whose sole interest is to cooperate with you to keep your boilers in fighting trim—a salaried technician with nothing to sell but his knowledge. This is the unique difference in Hall Service. Ask us to explain it.

HALL LABORATORIES, INC.

A subsidiary of Hagan Corporation

HAGAN BUILDING, PITTSBURGH, PA.

Hall Service in a Nutshell

At your immediate disposal are placed the technical knowledge and facilities of the pioneering leaders in scientific boiler water conditioning. In addition, with your full cooperation, Hall Service:

1. **Minimizes boiler outages caused by water.**
2. **Helps maintain highest efficiency.**
3. **Establishes non-embrittling water.**
4. **Minimizes carryover.**
5. **Prevents corrosion in boilers and associated equipment.**
6. **Prevents deposition in water lines and cooling systems.**

HALL SYSTEM
of Boiler Water Conditioning

HAGAN
HALL
BUROMIN
CALGON

Progress and Power in the

Hats off to America's Magnesium Industry! Deprived of foreign sources of supply and faced with the unprecedented demands of global war, the industry rose magnificently to the occasion . . . prospected and developed new ore fields . . . created new methods of extraction almost overnight.

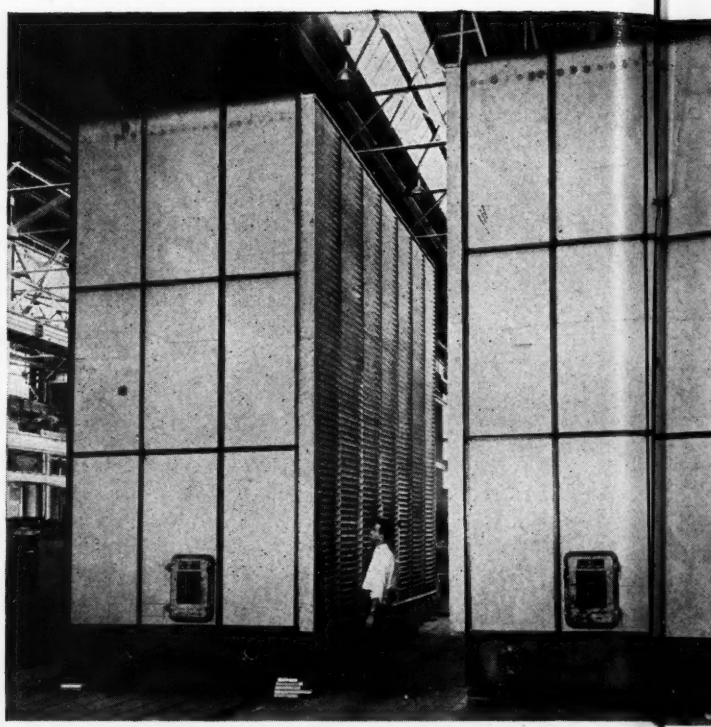
Throughout this crisis American Blower has strained every effort to share the load. In the magnesium plants and in the public utilities that provide them vital power, our Mechanical Draft equipment and Fluid Drives have played an increasingly important part.

We at American Blower are ready and alert for those post-war years when the Magnesium Industry and the public utilities of the nation will call upon our 60 years of engineering skill to aid in world-wide restoration.

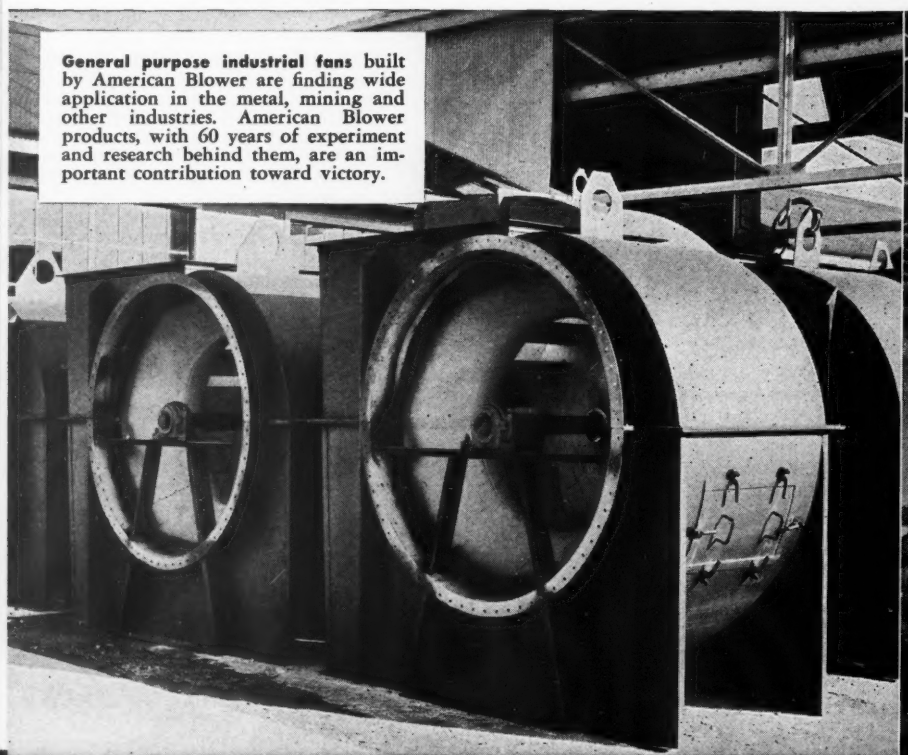
AMERICAN BLOWER

AMERICAN BLOWER CORPORATION, DETROIT, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO
Division of AMERICAN Radiator and Standard Sanitary Corporation

ARMY E NAVY
For excellence in production.



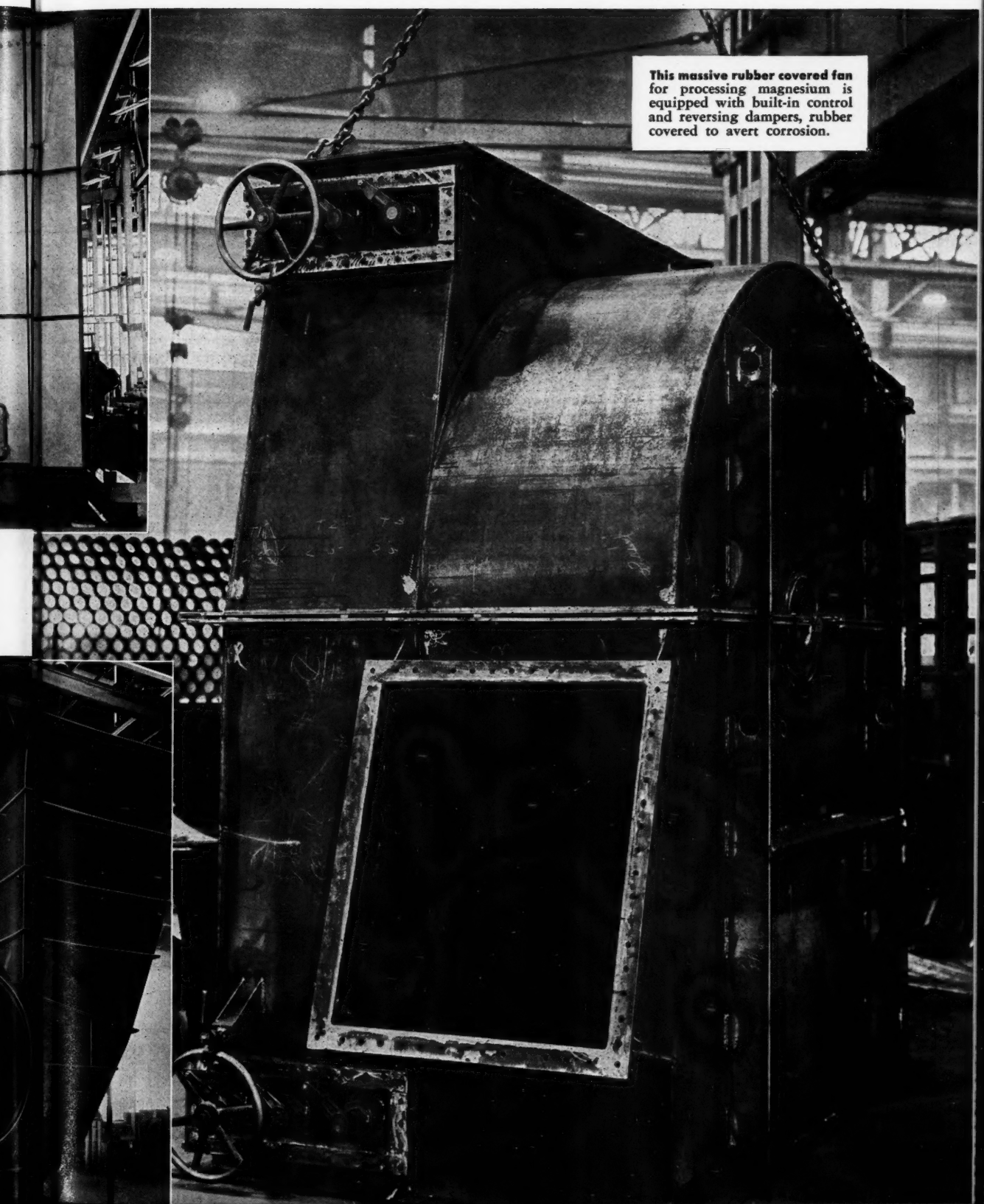
Giant washers for cooling and purifying air are essential equipment in process buildings where magnesium is extracted from its ore. American Blower washers of many sizes and types are custom-built to meet particular requirements of war industries.



General purpose industrial fans built by American Blower are finding wide application in the metal, mining and other industries. American Blower products, with 60 years of experiment and research behind them, are an important contribution toward victory.

Housing of heavy duty fan under construction for a magnesium plant. Fans of this type are used to circulate extremely corrosive chlorine gases in the magnesium process . . . are rubber-coated before shipment.

MAGNESIUM INDUSTRY



This massive rubber covered fan for processing magnesium is equipped with built-in control and reversing dampers, rubber covered to avert corrosion.

POWER— MORE and

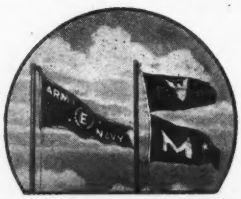
Electric power output has reached an all-time high —and is still moving upward. The increasing demands of industry are being met, as are also those for electricity for domestic use.

The credit for this almost miraculous situation belongs principally to the public utility companies, which in peace time correctly interpreted trends and prepared to meet what were certain to be unprecedented demands on their capacity.

In meeting these demands today, many of the central-stations have the help of newer types of Babcock & Wilcox Boilers, the High-Head, Radiant, Open-Pass, and Integral-Furnace. Each of these types definitely satisfies the requirements of some combination of operating conditions,as is evidenced by the fact that B&W boilers of these types alone in service have a nominal total steam-generating capacity of 42,000,000 lb. per hour.

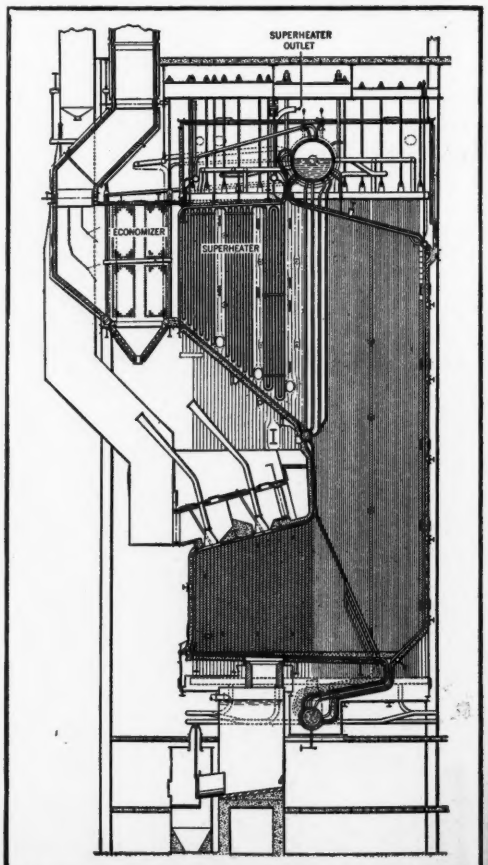
While we take understandable pride in the performance of our boilers, we feel that to the designers, engineers and operators of the public utilities belongs the real credit for meeting the demands of the industrial and domestic power consumers in this emergency.

THE BABCOCK & WILCOX COMPANY
85 LIBERTY STREET, NEW YORK, N. Y.



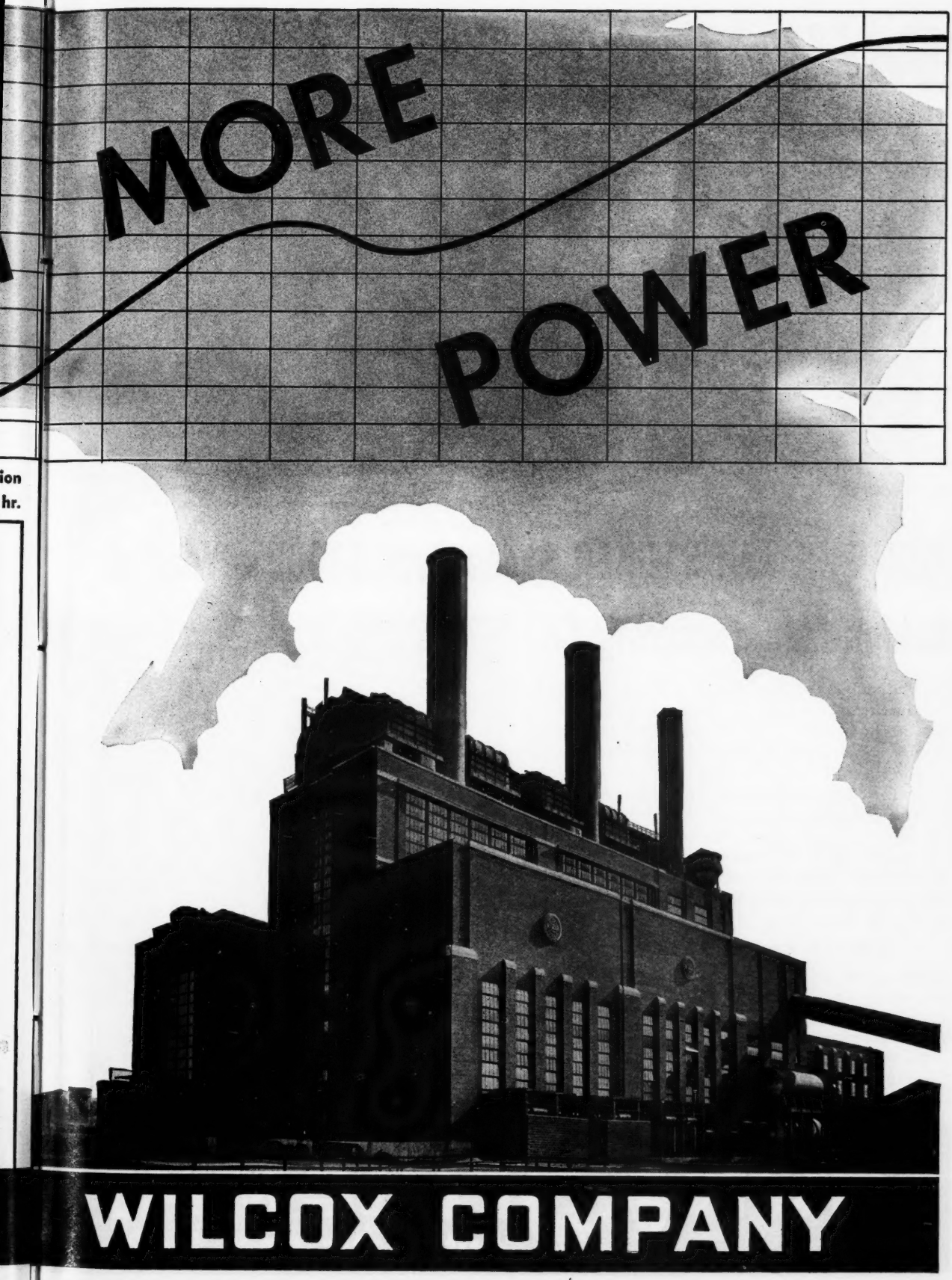
The Army-Navy "E" with two stars and Maritime Commission Award flags are floated proudly at the Barberton Works.

Typical B&W Radiant Boiler in Central-Station Service. Capacity 550,000 lb. steam per hr.



G-250T

THE BABCOCK &

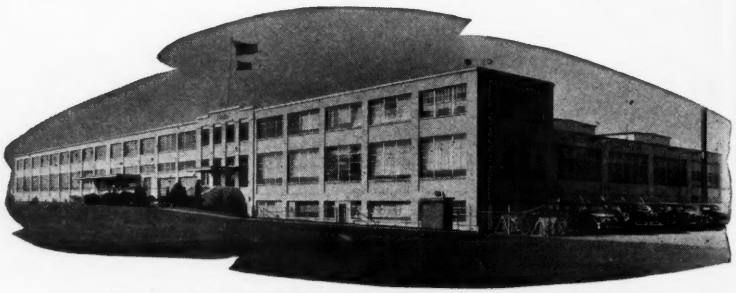


WILCOX COMPANY

Boiler Capacity Up...

Fuel Cost Down

WHIPPLE JACOBS, *President*
Belden Manufacturing Company



Exterior view of the Belden Manufacturing Company, Richmond, Indiana, well known makers of insulated copper wire, cable and cordage.

IRON FIREMAN STOKER Saves Over $3000 a Year at Belden Manufacturing Co.

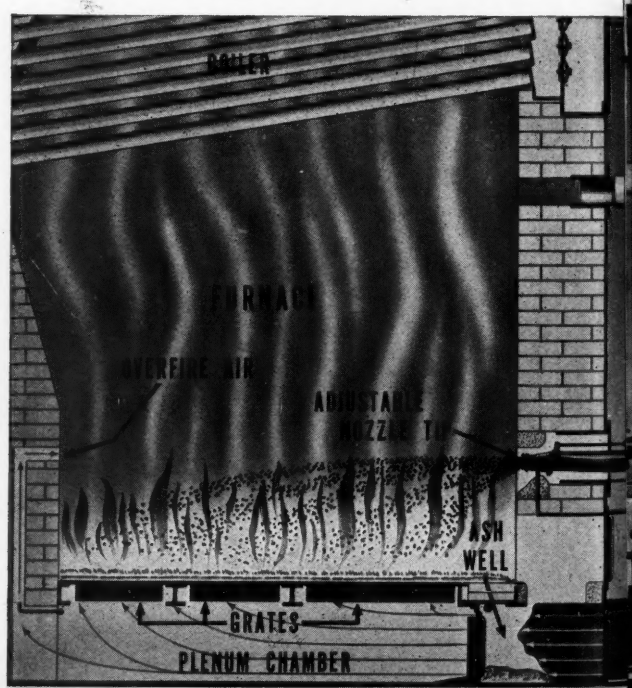
★ "In addition to providing a required increase in the capacity of our old boilers, we have reduced operating costs by $3,293 annually," reports D. D. McQuiston of the Engineering Department of Belden Manufacturing Company.

The Iron Fireman Pneumatic Spreader stoker model as used by Belden permits the use of local and lower cost coal, a vital advantage now when the transportation bottleneck presents serious difficulties. This greater efficiency and lower fuel costs are typical of thousands of war production plants that have changed to automatic coal firing.

Convert to Automatic Coal Firing Now

If your power or heating plant is now oil-fired, or if you operate an essential business or industry, you are eligible to apply for an Iron Fireman stoker under WPB regulations.

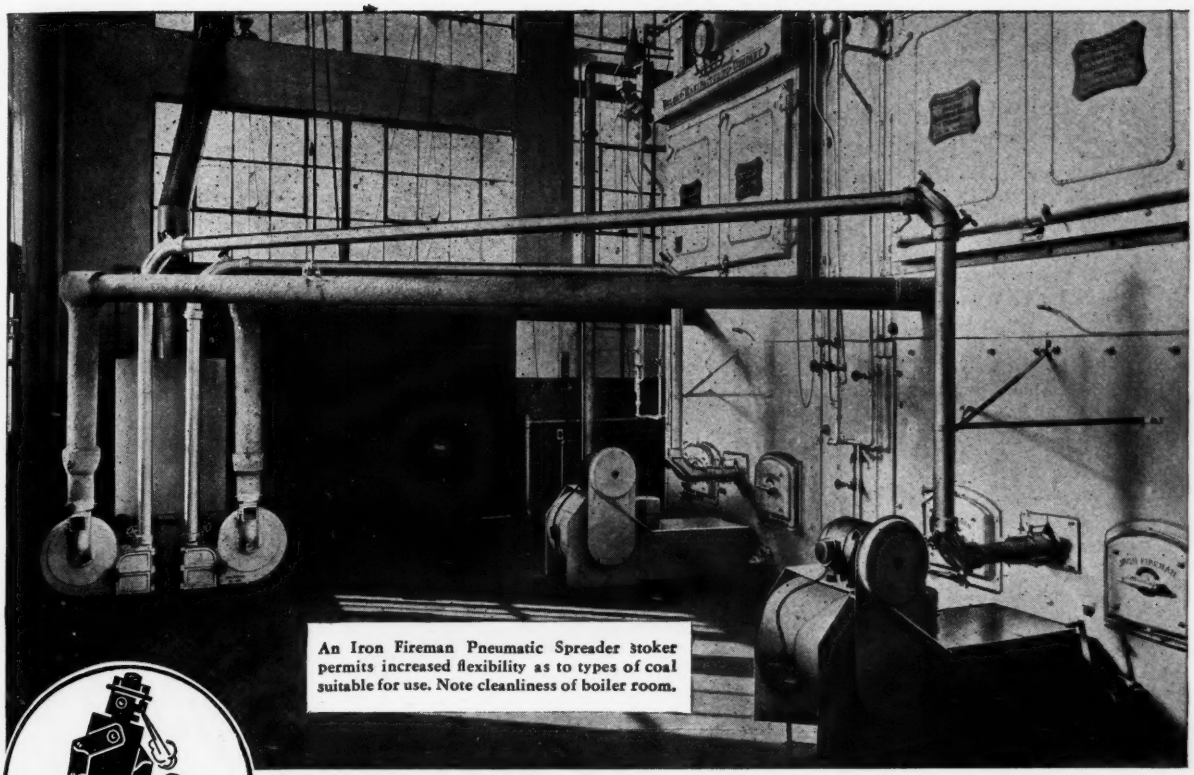
Phone, wire or write Iron Fireman Manufacturing Company, 3517 West 106th Street, Cleveland, Ohio.



IRON FIREMAN

THE IRON FIREMAN

Automatic Coal Stokers



An Iron Fireman Pneumatic Spreader stoker permits increased flexibility as to types of coal suitable for use. Note cleanliness of boiler room.

THE IRON FIREMAN
TRADE MARK
REG. U. S. PAT. OFF.

PREHEATED AIR PIPE

Coal Conveying Pipe

Nozzle Adjuster

Coal Nozzle

Forced Draft Fan Motor

Transfer Housing and Conveyor Fan Housing

Connection for Combustion Control

Conveyor Fan Motor

FORCED DRAFT FAN

COAL HOPPER

BUNKER-FEED MODELS

Coal is conveyed automatically from the bunker to the boiler

Coal Conveyor Pipe

Worm Housing Cleanout

Feed Worm

Coal Feed Motor

Transmission

FREE BOOK on Pneumatic Spreader Firing

Contains full descriptions, capacities, operating data, etc., with layouts and photos of 10 actual installations. Sent free, on request. Write to Iron Fireman Mfg. Co., 3517 W. 106th Street, Cleveland, Ohio.

★Stationary design
40,000 lb of steam per hr
★Marine design
C-E

supplied by C-E Victory Units

FOR NAVY YARDS ★ MUNITIONS ★ ARSENALS ★ ORDNANCE ★ ARMY & NAVY BASES ★ SYNTHETIC RUBBER ★ HIGH OCTANE GAS ★ MARITIME COMMISSION SHIPS ★ NAVAL VESSELS

All over our country today — actually in 19 different states — and in U. S. Maritime Commission and Naval Ships on every ocean, Combustion Engineering Victory Units are right up there in the front line for victory.

For VU Steam Generator contracts for such vital installations as those listed above now have an aggregate capacity of over 40,000,000 lb of steam per hr. This rate of steam output would be sufficient to serve about 13 per cent of the total fuel-generated kilowatt capacity of all the country's public utilities.

And this doesn't include other millions of pounds of steam that give added significance to the name Victory Unit. For in many industrial and utility plants from coast to coast VU Units are supplying the power to produce planes, tanks, food, oil, clothing, guns, instruments, and scores of other war products.

It's logical, too, for the VU Unit to play this important role in war production. In time of peace it had an established reputation for quality, reliability and efficiency, and thus was a natural choice for a war-time job where trouble-free operation and continuous service are primary considerations.

A 732

COMBUSTION ENGINEERING

200 MADISON AVE. **NEW YORK, N. Y.**

Scovill Tube News

Vol. 1 SCOVILL MANUFACTURING COMPANY, Waterbury, Conn. No. 6

Choosing the Right Alloy for Long-Lived Condenser and Heat Exchanger Tubes

Selection of Material

The selection of the alloy for any particular service, will depend upon the conditions under which it must operate. The many factors which must be considered in this connection have already been discussed. It is evident that each application of tubes in a condenser or heat exchanger is an individual problem which must be studied in detail before any specific recommendation can be made regarding the most economical and satisfactory tube material for use in the particular case. An investigation of this kind would cover not only a survey of all the known service conditions but would also take into consideration the alloy previously used and the type or form of corrosion previously experienced in the unit in question or in similar units operating under similar conditions. It is obvious that the subject can only be treated in a very general way without a consideration of all the essential facts which might apply to an individual case. The following information, therefore, is designed principally to give some indication of the conditions under which available condenser tube materials have given satisfactory service. In most cases it will be noted that two or more alloys may be used under a certain set of service conditions; in certain services, it is true that a rather wide choice of tube materials may be made without any appreciable difference in operating costs or service life. In other cases, where corrosion of some form is particularly severe, selection may be limited to one or possibly two of the more refractory materials.

Muntz Metal:

Nominal Composition, Copper 60%; Zinc 40%. Muntz metal tubes have been used extensively in both fresh and salt water service in steam condensers operating at relatively low temperatures. Use at the present time is confined chiefly to steam condensers at inland stations with fresh circulating water from rivers, lakes or wells. Muntz metal also has good resistance to hydrogen sulphide and other active sulphur compounds but is seldom used in applications where corrosion by such compounds is severe primarily because other factors, such as high temperature, high velocities, badly contaminated waters, etc., are usually active at the same time. Failure of Muntz metal tubes occurs usually as a result of gradual dezincification of the layer type. Muntz metal tubes in fresh water steam power plant installations have had a service life of twenty years or more.

Scovill's Analytical "Service In Manuals" Helps Many Firms Save Scarce Tube Metals

Both before and after installation of condenser or heat exchanger tubes, success depends on expert knowledge of the exact interrelation of tube alloys with the service conditions. This article is part of Scovill's continuing "Tube News" series; all preceding issues, dealing with tube manufacture, causes of corrosion, etc., are available on request, together with Scovill's up-to-date "Condenser Tube Booklet" covering the broad range of problems bearing on tube life. Address, Scovill Manufacturing Company, 17 Mill Street, Waterbury, Conn.

Admiralty Metal:

Nominal Composition, Copper 70%; Zinc 29%; Tin 1%. This alloy has excellent corrosion-resistant properties and is used widely in tube form in such diverse services as: steam condensers using fresh, salt, brackish or acid mine water for circulating purposes; heat exchangers, coolers, etc., in oil refineries where corrosion from sulphur compounds, acids and contaminated waters may be very severe; feed water heaters, heat exchanger equipment in industrial processes, etc. Admiralty metal tubes are often used in apparatus operating at temperatures of 400°F. or higher although severe dezincification of the alloy may be experienced under certain service conditions at elevated temperatures. Admiralty metal has a tensile strength of approximately 50,000 pounds per square inch in the finished annealed condition, together with excellent ductility. The strength of the alloy is retained up to a temperature of approximately 300°C. (570°F.).

Phosphorized Admiralty Metal:

Nominal Composition, Copper 70%; Tin 1%; Phosphorous 0.03%; Zinc remainder. The addition of a very small percentage of phosphorus to admiralty metal increases the dezincification-resistance of the alloy to a marked degree without impairment of the excellent chemical and physical properties of the alloy. Phosphorized admiralty metal was developed, therefore, particularly for installations where severe dezincification of admiralty metal has been experienced or is anticipated. Combining as it does resistance to dezincification and resistance to corrosion by sulphur compounds, acids, contaminated fresh and salt waters, etc., phosphorized admiralty metal has found wide usage.

Red Brass:

Nominal Composition, Copper 85%; Zinc 15%. Red brass is sufficiently high in copper content so that it does not dezincify under normal service conditions; it is also not as susceptible to season cracking or stress-corrosion cracking as brasses of lower copper content

and combines favorable physical and chemical properties to make it a very serviceable alloy for many heat exchanger installations. Red brass tubes have been used chiefly for service in contact with fresh waters although tubes of this alloy have also served very satisfactorily in uncontaminated salt water. This alloy is not generally recommended for use where corrosion by Hydrogen Sulphide or other active sulphur compounds is liable to be severe.

Deoxidized Copper:

Tubes of deoxidized copper (copper content 99.90%) are limited to applications where the high purity of the material is essential or where it is necessary to utilize the high thermal and electrical conductivity of pure copper. It has excellent resistance to practically all types of fresh water and to many chemicals. It is not usually serviceable in contact with salt water or active sulphur compounds. In the hard-drawn temper copper has a strength of approximately 60,000 pounds per square inch but it does not retain this strength at temperatures of 200°C. or higher.

Arsenical Coppers:

Nominal Composition, Arsenic 0.35%; Copper balance. The alloying of a small percentage (0.15–0.50) of arsenic with copper reduces the electrical and thermal conductivity of the copper 25% to 50%. Compared with deoxidized copper, arsenical copper has (1) a higher softening or annealing temperature (300°C. against 200°C.), (2) increased strength, hardness and stiffness of cold drawn material with no impairment of ductility, a higher fatigue limit, etc. Arsenical copper has been reported to be slightly more resistant to atmospheric corrosion than copper and equally as corrosion-resistant as copper in salt or fresh waters. Arsenical copper tubes find their principal usage in condensers and heat exchangers using fresh circulating water; they are not usually recommended for service in contact with hydrogen sulphide or other active sulphur compounds, with media carrying an appreciable percentage of organic acids, particularly in the presence of air (oxygen) or with acid solutions of an oxidizing character, such as acid mine waters. Their chief advantages over deoxidized Copper for heat exchanger service are (1) greater strength, (2) better resistance to erosion and abrasion, and (3) higher softening temperature.

Aluminum Brass:

Nominal Composition, Copper 76%; Aluminum 2%; Zinc 22%. The addition of approximately 2.00% of Aluminum to Brass of the above copper content, improves the resistance of the resulting alloy very materially, particularly to corrosion by salt and brackish waters and to combined erosion and corrosion in salt water service. The excellent corrosion resistance of this depends upon the nature of the film which develops over the surface of the tube. In service, this surface film is of the desired properties (thin, adherent, continuous, compact) to give excellent protection to the metal even under very severe water conditions; in addition the film is self-healing in case of a local breakdown, such as might occur through abrasion or erosion of the metal surface, making tubes of this alloy very serviceable in installations where tubes of other alloys might suffer rapid localized corrosion. Aluminum Brass tubes have been used quite extensively during the past ten years in marine condensers and in steam condensers of tidewater stations where relatively high velocities of the circulating water, together with turbulence and air bubble impingement, have a particularly severe local wearing action on Admiralty metal and other brass tubes.

70-30 Copper-Nickel:

Nominal Composition, Copper 70%; Nickel 30%. Tubes of this alloy are used in heat exchanger equipment under conditions where severe wear and corrosion have been experienced, particularly at elevated temperatures and at high velocity of the circulating media. Copper-Nickel tubes have given excellent service, for example, in ship condensers of the U. S. and British Navies, in steam condensers of tidewater stations where brackish or salt circulating waters are very corrosive, in various oil refining units operating at relatively high temperatures and in contact with corrosive materials, etc. 70–30 Copper-Nickel combines excellent corrosion-resistant properties with very favorable physical characteristics, such as high strength and extreme ductility. The strength of the alloy is retained even at relatively high temperatures. The thermal conductivity of this alloy is approximately one third that of Admiralty metal; actually, however, the heat transfer coefficient of a new unit is reduced only slightly when Copper-Nickel tubes are used in place of Admiralty metal. Some designers of heat transfer equipment allow 5% more tube surface area when Copper-Nickel replaces Admiralty or other brass tubes. Copper-Nickel tubes are not subject to season cracking or stress corrosion cracking so they may be used with safety either in the finished annealed or hard drawn condition. The preference at this time is for finished annealed tubes.

80-20 Copper-Nickel:

Nominal Composition, Copper 80%; Nickel 20%. The Copper-Nickel alloy containing 20% nickel has similar physical and chemical properties to the 70-30 Copper-Nickel and is, therefore, used in the same type of service, i.e., in marine and tidewater steam condensers, in oil refining installation, etc. The corrosion-resistant properties of the alloy are not equal to those of the higher nickel alloy so that the 70-30 alloy is still generally used under extremely severe conditions. In many cases, however, conditions may not be severe enough to justify the use of 70-30 Copper-Nickel and in such cases, 80-20 Copper-Nickel may give economical and satisfactory service.

THIS IS NUMBER SIX in a Series of Scovill Advertisements to help you get longer life from condenser and heat exchanger tubes.

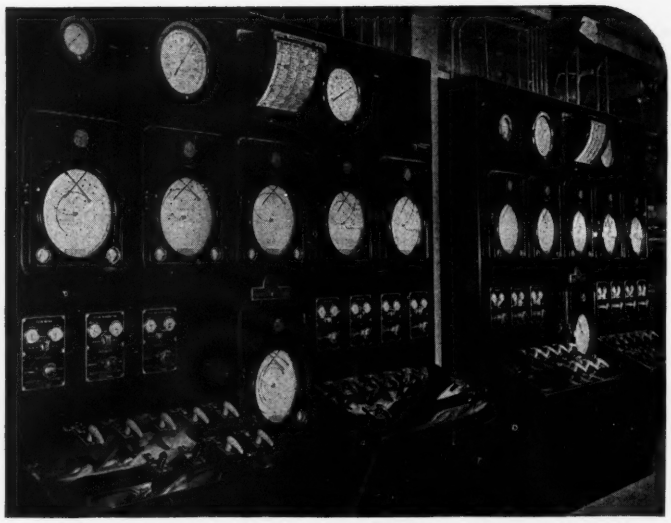
Scovill
MANUFACTURING COMPANY
WATERBURY, CONN.

SCOVILL CONDENSER TUBES

ONE PRODUCT... THREE SERVICES

Service in Manuals... Service in Metals... Service in Men

ESSENTIAL IN *WAR*
PROFITABLE IN *Peace*



Bailey Boiler Control Panels for two 135,000 lb. per hour capacity, oil and gas-fired boilers in a Western Power Station.

Bailey Boiler Control Conserves Fuel, Insures Safety, Increases Turbine Efficiency, Improves Continuity of Service and Simplifies Training of Operators

The same qualities of Bailey Boiler Control which make it essential in wartime power plant operation, make it profitable to use in peacetime operation.

It conserves fuel and fuel transportation facilities by automatically maintaining the correct fuel—air ratio for efficient combustion at all times.

It insures against accidents to operators and equipment by:

Accurate control of boiler water level, steam temperature and fuel—air ratio.

Interlocks to insure the proper sequence of operation.

Limiting devices to prevent operation under unstable conditions.

Alarms to warn operators of dangerous conditions such as high or low water level, flame failure, loss of air pressure, etc.

It increases turbine efficiency by supplying steam at design pressure and temperature at all times.

It improves the continuity of service by reducing furnace and boiler repairs.

It simplifies training of new operators and insures continuous economy during the training period.

These same qualities of Bailey Boiler Control which are now helping to win the war will help American industry to win the peace.

Suggestions for wartime boiler plant operation are given in our Bulletin No. 16 "How to Safely Stretch Steaming Capacity." Ask for your copy now. A-90

BAILEY METER COMPANY

1040 IVANHOE ROAD • CLEVELAND, OHIO

Bailey Meter Company Limited, Montreal, Canada

BAILEY METER CONTROL

The Complete Combustion Control System

BOILER METERS • MULTI-POINTER GAGES • FLUID METERS • RECORDERS • SUPERHEAT CONTROL • DESUPERHEAT CONTROL • COMBUSTION CONTROL • FEED WATER CONTROL

TO MARK PROGRESS

Controlled Quality...

The Ladish Drop Forge Co. symbolizes over 41 years of continuous service to American Industry. Forward-looking scientific experts, outstanding manufacturing facilities and exacting metallurgical control have been combined to produce unexcelled, controlled-quality forged steel flanges.

FITTINGS DIVISION

LADISH DROP FORGE CO.

CUDAHY [MILWAUKEE SUBURB] WISCONSIN

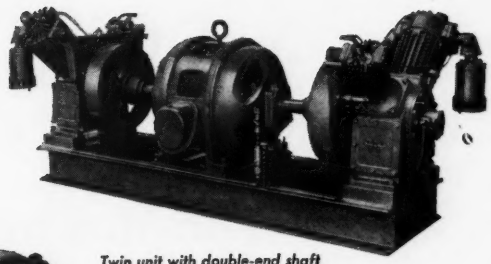
FLORI helps invasion. Recently we equipped invasion barges with fuel oil lines, sea water lines, bulk head connections, propeller skegs — an order of about 70,000 pieces completed ahead of rush schedule.

We can make anything in tubular or plate steel fabrication: Fabricated Piping — for steam, water, air, oil, gas, chemicals • Random mill or cut lengths, bent, coiled, welded, flanged, threaded • Valves, Pipe Fittings. *Send your inquiries.*

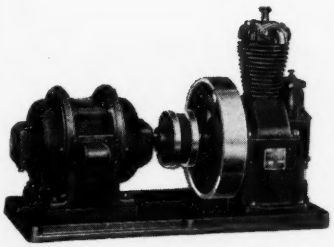
FLORI PIPING

THE FLORI PIPE COMPANY • ST. LOUIS — CHICAGO

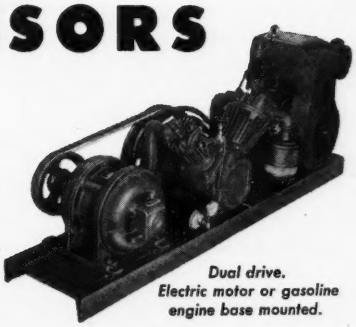
WORTHINGTON Vertical COMPRESSORS



Twin unit with double-end shaft motor on steel base



Unit direct connected to electric motor



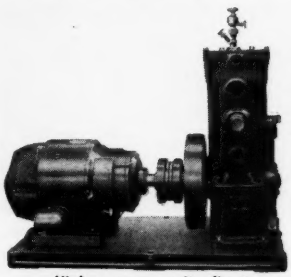
Dual drive. Electric motor or gasoline engine base mounted.

24 Sizes

344 Arrangements

Capacities to 164 c.f.m.

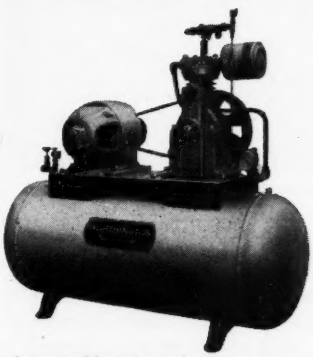
Pressures to 1000 lbs.



High-pressure unit direct connected to electric motor

War production plants are now using these units in a total of more than two million horsepower. To any plant whose needs for compressed air fall within the above range, Worthington compressor equipment offers advantages that can contribute greatly to stepped-up output. They are built for users who demand the best equipment.

The following features make Worthington compressors the choice of careful purchasers.

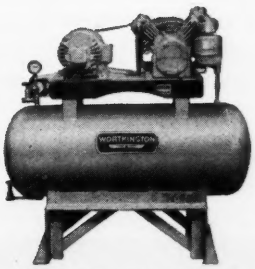


Tank-mounted belted unit showing pressure regulator control

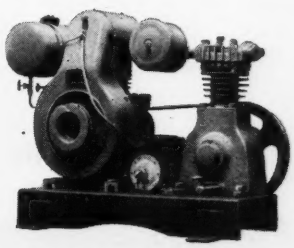
- One-piece Feather Valve . . . lightest, simplest, most efficient.
- Close-grained nickel iron cylinder, honed to mirror surface . . . generously finned for efficient cooling.
- Ground piston, closely fitted in cylinder . . . two compression rings and two oil rings . . . for oil-free air discharge.
- Full-floating wristpin . . . retainer spring prevents scored cylinder.
- Extra-long drop-forged heat-treated connecting rod . . . reduces cylinder wear. Shim-adjusted babbitt crankpin bearing. Graphite-bronze wristpin bushing.
- Drop-forged heat-treated integrally-counterbalanced crankshaft . . . journals ground and polished.
- Adjustable Timken main bearings . . . controlled splash lubrication.
- Force-feed lubrication to all shaft bearings . . . adjustable babbitt main bearings.
- Shaft oil-seal keeps compressor installation clean and oil-free.
- Crankcase ventilator . . . well baffled . . . keeps oil in, and dust out.
- Cast-iron belt wheel with fan spokes . . . good cooling decreases power required.

Worthington vertical compressors are available to those manufacturers whose war production activities give them priority. An authorized Worthington industrial dealer or district office engineer will be glad to assist you with the correct selection for your requirements.

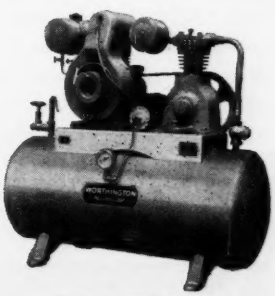
Unit mounted on Massachusetts code vertical tank



Massachusetts code horizontal tank-mounted compressor unit



Base-mounted unit with gasoline engine drive



Tank-mounted unit with gasoline engine drive

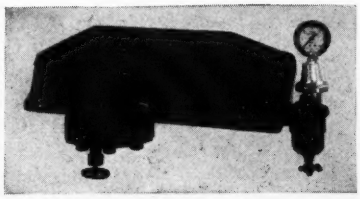
AC3-1A

WORTHINGTON PUMP AND MACHINERY CORPORATION · HARRISON, NEW JERSEY

A COMPLETELY NEW PNEUMATIC TRANSMITTER

For Measuring Flow and Level

A new metering device operating on the Force-Balance Principle



The Republic Differential Pressure Transmitter.

Republic announces an entirely new type of pneumatic meter which has been thoroughly field tested during the past two years. The Republic Differential Pressure Transmitter is a simple pneumatic device for converting a differential pressure, such as is produced by the flow of a fluid through an orifice or by liquid level in a vessel, into an air pressure which varies proportionately with the differential pressure.

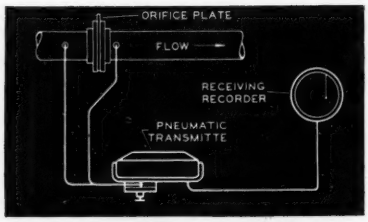
This air pressure is used as a direct measure of the differential pressure and can be conducted to a remote location by means of tubing. A gage or receiver connected anywhere in this transmission line will show the variations in the differential pressure and may be graduated in terms of the flow or level which it represents. The pressure can also be utilized as the impulse for actuating a controller.

RANGES—standard ranges are available from 0.9 in. to 25 in. of water differential, for working pressures up to 15 psi.; 7 in. to 50 in. of water for working pressures up to 25 psi.; and 13 in. to 800 in. of water for working pressures up to 600 psi. Special heads can be provided for working pressures up to 2000 psi.

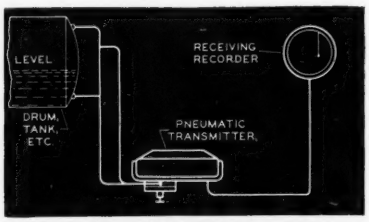
ACCURACY of the Republic force-balance method of measurement is higher than can be consistently secured and maintained with any other method. Transmitting pressure vs measured differential is guaranteed within ½ of 1% of meter range.

SENSITIVITY—due to the negligible motions required for complete operation of all parts for full scale change, no appreciable hysteresis results from reversal of direction of measurement change. The hysteresis loop is so small that it is undetectable by ordinary means, being less than 1/20 of 1%.

RESPONSIVENESS—due to the fact that there is virtually no volume displacement, the Republic Pneumatic Transmitter is able to follow flow changes almost instantaneously. The time required to produce full output pressure at the transmitter is in the nature of fractions of a second, after the differential is imposed. Therefore a receiving instrument installed adjacent to the transmitter will show flow changes almost instantly. With 500 feet of ¼ in. O.D. tubing, the full value of the change will have registered on a Republic receiver in 15 seconds. This is the overall lag in the system not merely, the transmission lag.



Typical installation for measuring flow.



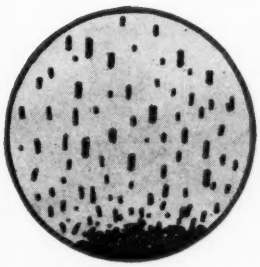
Typical installation for measuring liquid level.

For complete data write for Bulletin No. 43-4

REPUBLIC FLOW METERS CO.
2224 Diversey Parkway, Chicago, Illinois

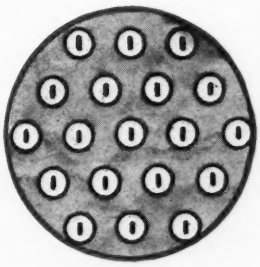
How Detergency operates

Cross-sections illustrating oils in use



Non-Detergent

In this type of oil, carbon, oxidation products, dirt, etc., stick to each other and to engine parts . . . deposit in rings, on valves, clog filters, etc.



Detergent

In this type of oil, film *coats* carbon, dirt, etc., prevents particles sticking, holds them in suspension until trapped by filter or drained from engine.

New Detergency for low speed Diesels

Patented ingredient in new Nonpareil H. D. Diesel Oil brings new cleanness and stability . . . reduces wear.

● THE GREAT benefits of detergency (see diagram), so highly valued for high-speed Diesels, are now made generally available for low-speed engines, through the introduction of new Nonpareil H.D. Diesel Oil. This addition to our Nonpareil line brings a step-up in engine cleanness that can be noticed quickly. It not only keeps engines cleaner, but in many cases will remove deposits left by other oils.

The detergency results from the use of an additive which is both a detergent and an oxidation inhibitor. This gives the oil a new high stability, lengthens oil life, and greatly aids in bringing clean engine operation. It also reduces wear.

The combination of all these qualities brings a practical end to troubles from (a) ring-sticking and piston scuffing, (b) excessive sludge deposits, and (c) excessive gum deposits.

Application of Detergent Type Oils. Many engines give clean operation with conventional oils, but where dirty operation cannot be corrected by mechanical adjustment, the use of detergent type Nonpareil H.D. Diesel Oil is indicated. A Standard Lubrication Engineer will gladly advise you whether a conventional or detergent type oil will give you the best possible results in your Diesels.

Cleanness Aided by Base Stocks and Refining. Nonpareil H.D. Diesel Oil comes in two grades: Medium and Heavy; and is offered in addition to our regular line of Nonpareil Diesel Oils. This line, over a period of many years, has established a fine record for engine cleanness and low engine wear . . . the results of careful refining plus the use of high quality stocks. Nonpareil H.D. Diesel Oils have the same high quality plus the addition of the detergent-oxidation inhibitor.

The new oils have been thoroughly tested and proved in the laboratory and field. In every case, the results have been outstanding. Why not let a Standard Lubrication Engineer help you select the grade suitable for your service? Make a test in some unit in which conditions are severe. Phone or write for the Engineer nearest you.

Ask about this New Oil!

Get the full facts about this great new oil, how its characteristics fit it for a wide variety of service conditions. Note its applications to various makes and models of Diesels, etc. Call any Standard Oil (Indiana) office, or write 910 South Michigan Ave., Chicago, Illinois. In Nebraska, address any Standard Oil Company of Nebraska office.

New
NONPAREIL H. D. DIESEL OIL

OIL IS AMMUNITION . . . USE IT WISELY

STANDARD OIL COMPANY (INDIANA) STANDARD SERVICE

LUBRICATION ENGINEERING • • LUBRICATION ENGINEERING • • LUBRICATION ENGINEERING • • LUBRICAT

EXIT the asphaltene-forming hydrocarbon

(a message to turbine oil users)

Let a hydrogen atom meet a carbon atom down in the earth, and they unite. They have a "yen" for each other.

In petroleum, they are united in countless combinations to form highly complex hydrocarbons. Some of these are unstable. They have an affinity for oxygen. They "drink it in." Then they're oxidized and ready to go on a rampage. In turbine oil, that means deposits, acidity, sludge, poor demulsibility -- trouble! Some of these little devils tend to form asphaltene substances, others to form acids. The asphaltene kind can all be removed by refining -- but generally are not. Those left act like poor apples in a barrel. Conventional methods fail to get all of them out unless a high degree of refining is used.

Without the use of inhibitors, such refining is undesirable because stable hydrocarbons -- including valuable natural inhibitors -- are also removed. Nonpareil Turbine Oil is a highly refined oil to which has been added a patented inhibitor. When you use Nonpareil, you never will have any troubles from deposits, sludge, or poor demulsibility due to asphaltenes. Acid-forming hydrocarbons are another story. They can't all be removed by refining. How we render them harmless

will be told in our advertisement next month.

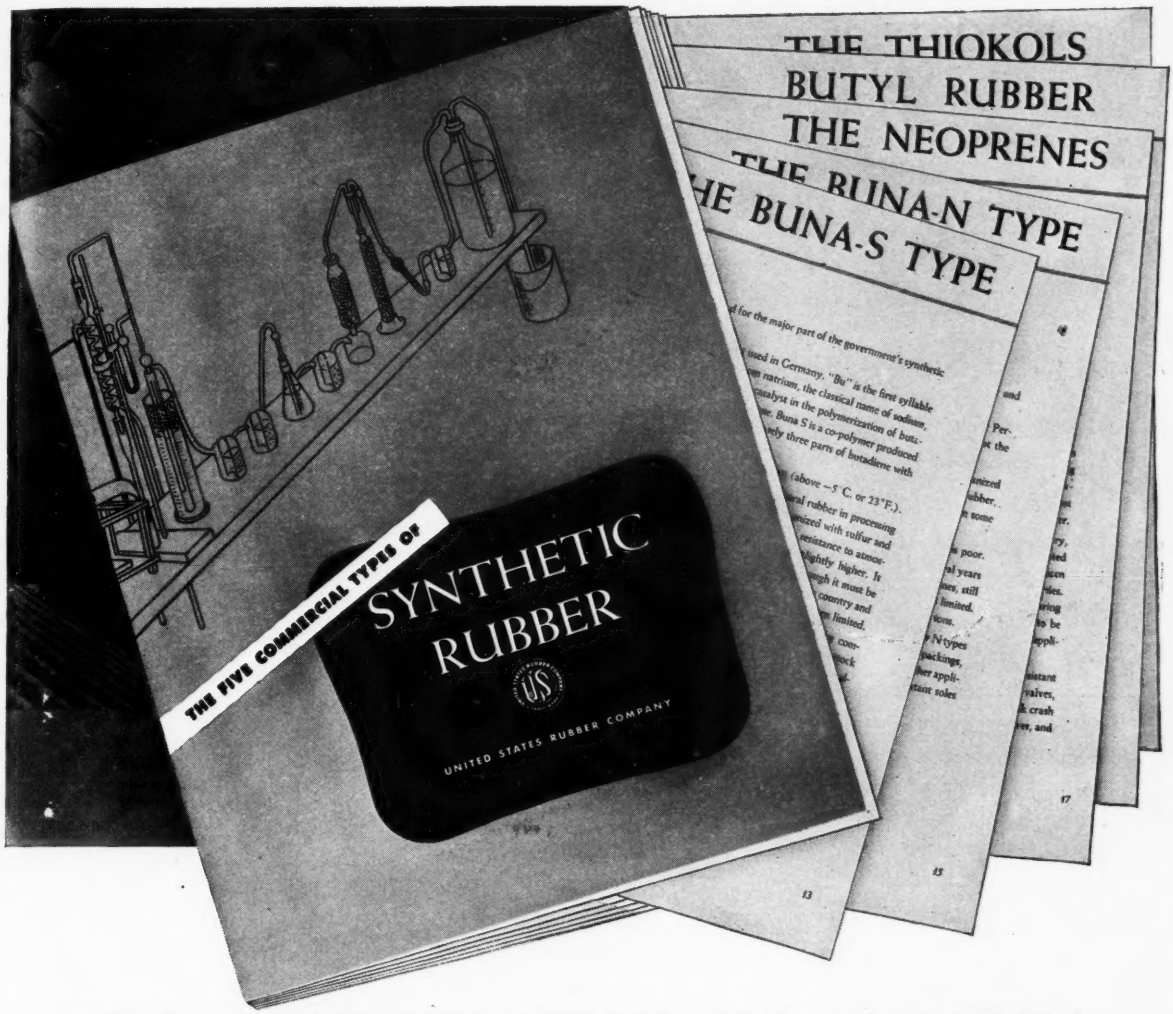
Meanwhile, if you want further information, send for a Standard Lubrication Engineer. Write or phone the nearest Standard Oil Company (Indiana) office, or 910 South Michigan Ave., Chicago, Ill. In Nebraska, write to Standard Oil Company of Nebraska at Omaha.

NONPAREIL TURBINE OIL

Oil Is Ammunition . . . Use It Wisely

STANDARD OIL COMPANY (INDIANA) STANDARD SERVICE

★ LUBRICATION ENGINEERING



WHAT IS SYNTHETIC RUBBER? HOW IS IT MADE? WHERE IS IT USED? HOW DOES IT COMPARE WITH NATURAL RUBBER? *You'll find the answers in this new book*

As the supply of natural rubber diminishes, undoubtedly more and more mechanical goods will be made of synthetic rubber... hose, belts, packings, molded goods, tank linings, and other rubber products used by industry.

Having worked in the field of synthetic rubber for more than twenty years, we know what each of the five types will do; what chemicals such as sulfur, carbon-black, or ultra-accelerators must be added, and how to compound them. We work with all five types; use the type available that is best suited for the purpose.

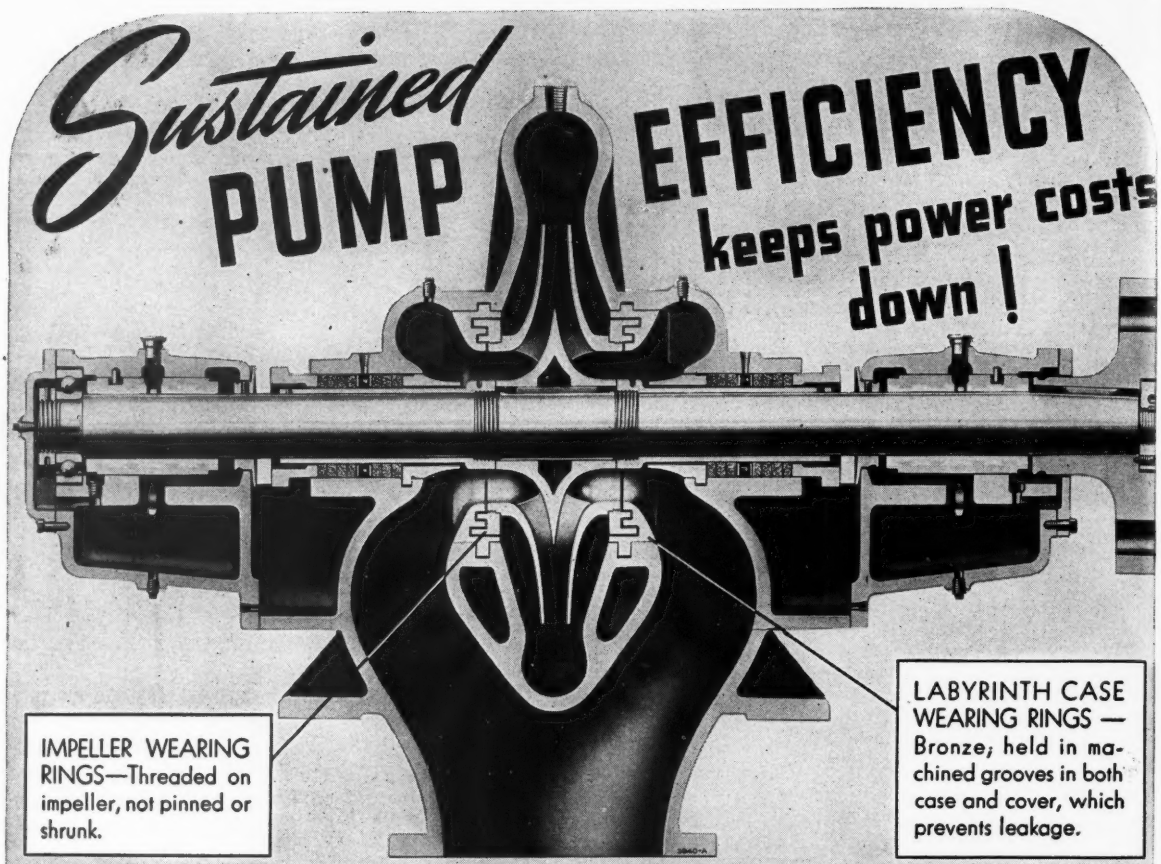
You can get an over-all picture of the properties and characteristics of synthetic rubber in the new book recently published by United States Rubber Company. A request for "The Five Commercial Types of Synthetic Rubber" made on your company letterhead will be filled promptly. Address your letter to Dept. 18

UNITED STATES RUBBER COMPANY

Listen to the Philharmonic Symphony program over the CBS network, Sunday afternoon 3:00 to 4:30 E. W. T. Carl Van Doren and a guest star present an interlude of historical significance.

1230 SIXTH AVENUE • ROCKEFELLER CENTER • NEW YORK
IN CANADA: DOMINION RUBBER COMPANY, LTD.

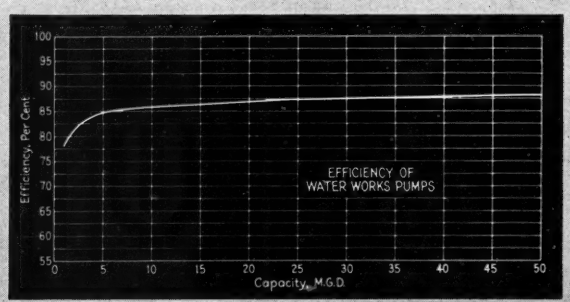
Sustained PUMP EFFICIENCY keeps power costs down!


IMPELLER WEARING RINGS—Threaded on impeller, not pinned or shrunk.
LABYRINTH CASE WEARING RINGS — Bronze, held in machined grooves in both case and cover, which prevents leakage.

Initial high pump efficiency is sometimes obtained by the use of excessively close clearances between wearing rings, but, attained in this way, it is not long maintained, particularly where flat rings are relied upon.

DE LAVAL LABYRINTH WEARING RINGS are distinct because, without resort to close clearances, they make possible high pump efficiency, which is maintained over a long interval, as demonstrated, for instance, by two 25 m. g. d. De Laval pumps in the Shawmont Station, Philadelphia.

Unit No. 4 in the acceptance test on January 22, 1927, showed a wire-to-water efficiency of 82.7 per cent and, when tested again on January 20, 1933, an efficiency of 83.9 per cent.



Efficiencies attainable with various capacities at heads between 125 and 225 ft.

Similarly, Unit No. 5 on the acceptance test on March 3, 1927 showed 83.3 per cent efficiency and, when tested again on January 31, 1933, it showed 83.9 per cent.

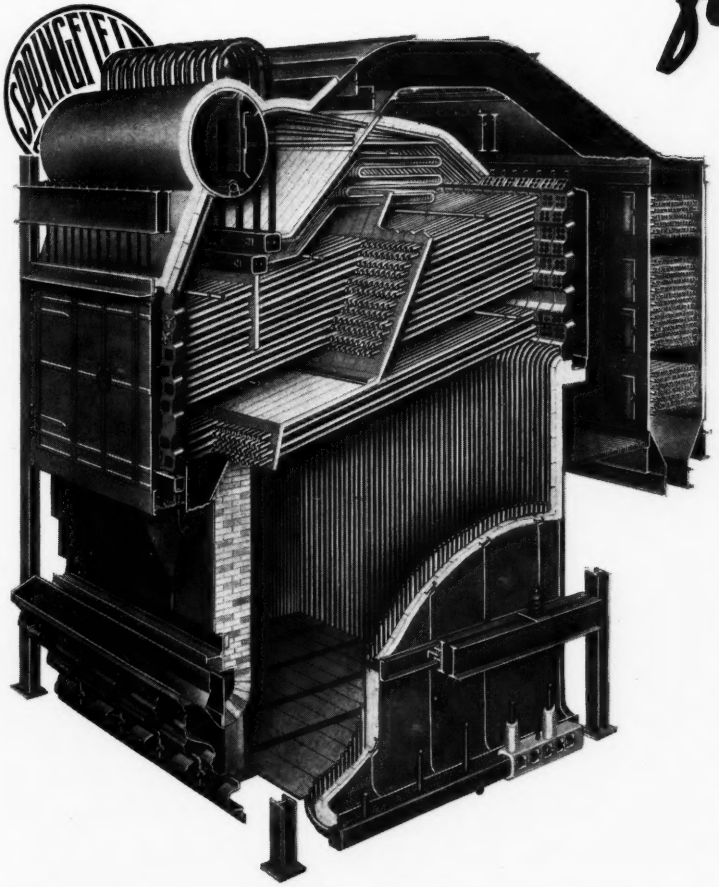
•

For further particulars and other instances, ask for Publication P-3225.

DE LAVAL STEAM TURBINE CO. . . TRENTON, N. J.

FEATURES THAT SAVE TIME!

30 to 60 Days Earlier Completion for War Plants!



ACTUAL records on recent war plant boiler installations reveal that Springfield's design and method of fabrication and erection has cut from 30 to 60 days off the time commonly required for completion of the boiler installation. This important advantage is made possible by several factors.

★ **SHOP ASSEMBLED SECTIONS.** Sections of 3" tubes rolled into rugged electric cast steel headers are assembled complete with baffles in our shop saving weeks or months in field construction time, depending on the size of the units. Water walls are also shop assembled where field conditions permit.

Each section is hydrostatically shop tested and inspected at pressure at least 50% over working pressure and never less than 500 lbs. Springfield's distinctive 4-tube grouping arrangement, combined with the sinuous headers gives each section rigidity and strength to withstand handling in shipping and in the field. Valuable time and labor savings, particularly on shipments going into overseas locations.

★ **COMPLETE 90% OF INSTALLATION BEFORE DRUM ARRIVES.** Delays in getting steel plates for drums is a minimum retardant on Springfield jobs. The setting can be put in, tubes, headers, water walls, auxiliaries installed—all before the drum arrives for connection.

★ **SINGLE DRUM.** A minimum amount of steel plate is diverted from shipbuilding and other urgent uses when the Springfield design is used. Cast steel, the material selected for turrets and hulls of newest Army tanks, has long been used by Springfield to produce better headers for boilers and water walls. With one size of straight boiler tube, Springfield averages about 1/16 fewer tube sizes than common bent tube boilers.

★ **DELIVERY.** Springfield shops are not loaded up with mass production of standardized boilers. Immediate attention can be given to units to meet the most special needs. Write, phone or wire for quotations. SPRINGFIELD BOILER CO., 1951 E. Capitol Ave., Springfield, Ill.

DUPLICATE UNITS

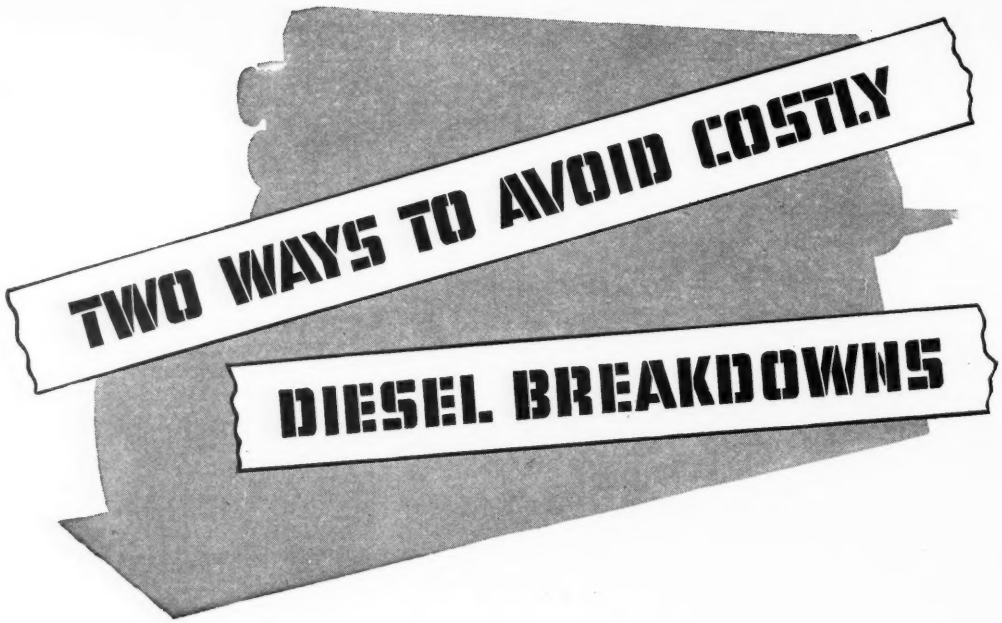
COMPLETE drawings, patterns, shop, fixtures, etc., are on hand to duplicate any of the many modern Springfield steam generating units built in recent years. Capacities from 5,000 lbs. to 450,000 lbs. per hour, or more. Pressures from 75 lbs. to 750 lbs., or higher. Springfield regularly takes contracts for complete steam generating units.

SPRINGFIELD

STEAM GENERATING UNITS

SPRINGFIELD BOILERS

ANY SIZE ANY FUEL ANY PRESSURE



1. KNOW WHAT YOUR DIESEL NEEDS!

Get the expert advice of a Cities Service Diesel Lubrication engineer. (No cost or obligation.) He'll study the needs and problems of your particular job, and work out a plan to reduce breakdowns and costly repairs—and keep your Diesels running at peak efficiency.

In his work, he'll use the Industrial Heat Prover (exclusive with Cities Service), an instrument which eliminates guess-work in analyzing combustion problems.

2. USE SERVICE-PROVED LUBRICANTS!

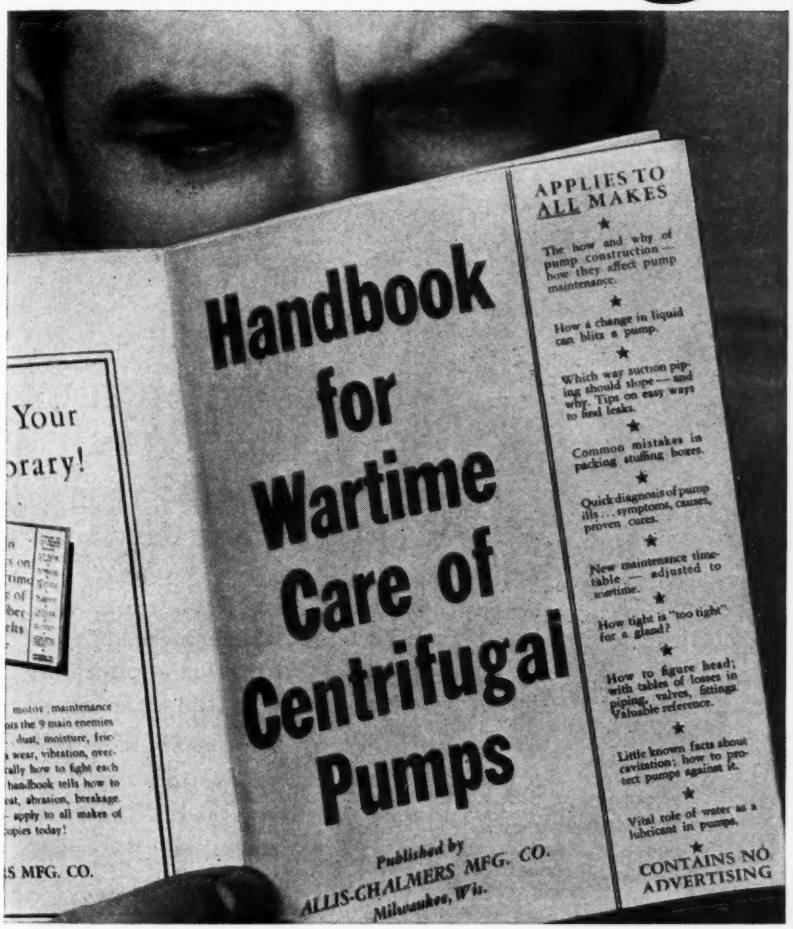
Cities Service will supply you with *precision-perfect* lubricants which have been long tested under the tough demands of all-out operation —and have proved powerful allies in achieving steady, flawless, economical operation. For full information about the proper type and grade of Cities Service Diesel lubricant required by your equipment, get in touch with your nearest Cities Service Office.

An informative booklet on "Diesel Engine Lubrication" has been prepared by our engineering staff and is available to users of Diesel engine oils *without charge*. Write Room 1653, Sixty Wall Tower, District 5, New York, for your copy today.

OIL IS AMMUNITION—USE IT WISELY!

CITIES SERVICE OIL COMPANY
NEW YORK · CHICAGO
IN THE SOUTH
ARKANSAS FUEL OIL COMPANY
SHREVEPORT, LA.

Required Reading!


Handbook for Wartime Care of Centrifugal Pumps
APPLIES TO ALL MAKES
Published by ALLIS-CHALMERS MFG. CO. Milwaukee, Wis.
CONTAINS NO ADVERTISING

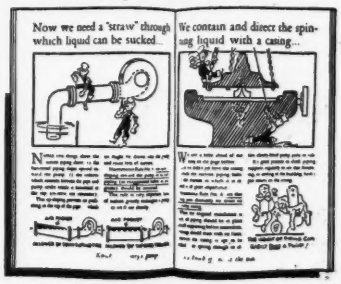
Your copy is free! Allis-Chalmers will gladly mail copies of "Handbook for Wartime Care of Centrifugal Pumps" *free of charge*. It applies to *all* makes — contains no advertising. Use it to make present pumps last — and when you *do* need new pumps, look into the extra efficiency and long life built into Allis-Chalmers centrifugal pumps . . . all types for every purpose.

ALLIS-CHALMERS
MILWAUKEE

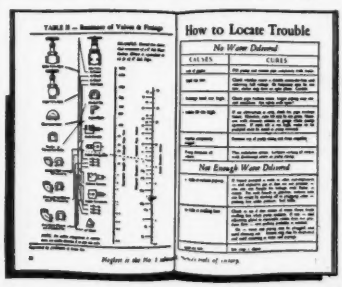
WE WORK FOR VICTORY — WE PLAN FOR PEACE

PUMPS NOW DO 4 TIMES THEIR NORMAL WORK - NEED THE FINER KIND OF CARE SET FORTH IN ALLIS-CHALMERS' NEW HANDBOOK!

EVERY EXECUTIVE, engineer and operating man should have a copy of this important new publication in his technical library. Pumps doing wartime work (8700 instead of 1800 hours a year) need *wartime care!*



To make principles of pump maintenance crystal-clear a pump is *built!*



Contents include valuable tables of friction losses, a guide to locating trouble, a maintenance timetable geared to *wartime!* Get *your* copy!

ALLIS-CHALMERS MFG. CO.
Milwaukee, Wisconsin

Gentlemen:
Yes, I would like to receive *free of charge* a copy of your "Handbook for Wartime Care of Centrifugal Pumps".

(Name)

(Title)

(Company)

(Street Address)

(City and State)

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Cochrane Corporation
3123 N. 17th St., Phila., Pa.

Please send me a copy of your new Publication on Carbite Softeners

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State.....

Will CARBONACEOUS ZEOLITES apply to your softening problems?

Cochrane's new Publication 4021 contains a wealth of material of great value in estimating the applicability of this system in the solution of your water conditioning problems.

A Partial List of Contents:

APPLICATIONS
CHEMICAL REACTIONS
SODIUM CYCLE SOFTENING
ACID CYCLE SOFTENING
BLENDING
DECARBONATOR
TYPICAL ANALYSIS
TYPICAL INSTALLATIONS
CONTROL MEANS FOR BLENDING

Use Coupon in upper left corner or write giving details of specific problems.

COCHRANE CORPORATION PHILADELPHIA, PA.

COCHRANE

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"I HAVE THE GOOD OLD *Let's Go* SPIRIT TOO!"

CASH STANDARD *Streamlined* PRESSURE REDUCING VALVE TYPE 1000

"I am the CASH STANDARD Streamlined Type 1000 PRESSURE REDUCING VALVE — streamlined for uninterrupted maintenance-saving performance — for smooth, even flow of steam, water, air, oil, etc. I am imbued with the will to go along with the top notch operation that plants aim for. There are no weak spots in my make-up — nothing that will cause you to frown on me or for that matter, to give me any particular attention once I am in your service. Cooperation with my boss and all the other equipment is my life's work — no loafing on the job whether it's one shift a day or three. I am all out to give all — all the time. It's the will to win in good times or bad — under ordinary or tough conditions that gets things done and I am all for it — so, let's go!"

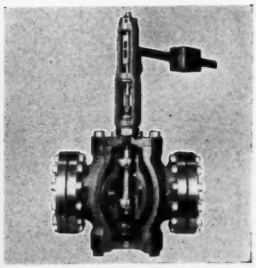
You Get All This

- Trouble-free service
- Smooth operation
- Tight closure
- Accurate regulation
- Elimination of failures
- Constant delivery pressure
- No spoilage
- Practically zero in maintenance costs
- Speedier production results
- Cost saving operation

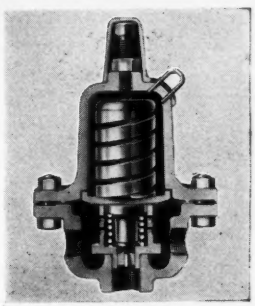
CASH STANDARD CONTROLS .. VALVES

A. W. CASH COMPANY
DECATUR, ILLINOIS

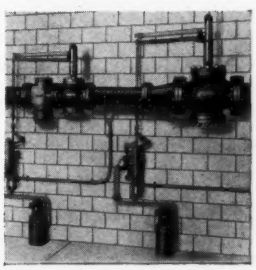
OTHER VALVES *from the* CASH STANDARD LINE



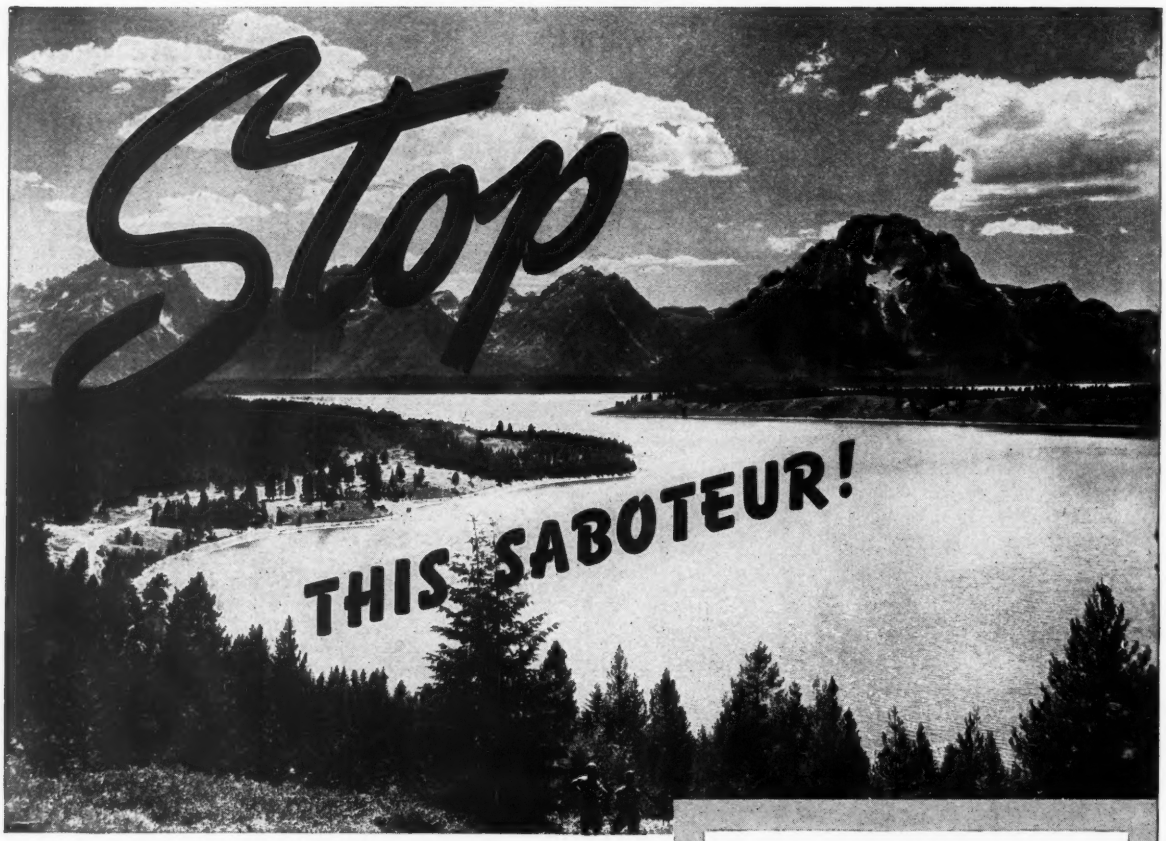
For precision jobs — the CASH STANDARD "42-R" Balanced Lever Valve. No lost motion; practically no maintenance. Heavy renewable seat rings; valve stem integral with inner valve. Roller guides kill side strains and stop packing trouble. Sizes ½" to 12"; pressures up to 600 lbs. Highest temperature 800 deg. F. In iron, bronze, and steel bodies; all standard trims. This valve is made also with center guide, and with Water Cooled, or Air Cooled Packing Box.



Cash Standard Type Q Relief Valve; maintains constant upstream pressure by relieving into lower downstream pressures, regardless of variations in downstream pressure. For steam, water, air, oil, many gases. Iron or bronze bodies; bronze trim; pressures up to 350 lbs.; top temperature 500° F. Screwed ends; sizes ¼" to 2".



Where valve failure would be costly, here are two "42-R" valves operated by CASH STANDARD Type 100 Automatic Controllers, in two-stage pressure reduction. First stage: a 5" Valve reducing 150 to 50 lbs. gauge; second stage: an 8" Valve reducing 50 to 5 lbs. gauge. Load 70,000 lbs. steam per hour. Nearly four years' daily use; not a moment's trouble.



Guards at every gate may protect your plant from human saboteurs. But what protection are you providing against other saboteurs . . . who enter your plant unchallenged through the water mains?

The innocent appearance of water may be a perfect disguise for saboteurs which can slowly, but surely, destroy vital parts of your power plant. Unless properly conditioned against scale, corrosion embrittlement, carry-over, etc., water can be as damaging to vital production as a bombing!

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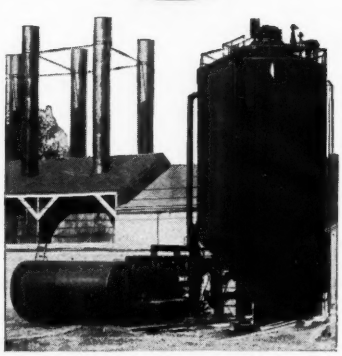

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1 Pill for 9 Headaches!

PAGES FROM "A GUIDE TO WARTIME CARE OF ELECTRIC MOTORS"

Electric Motor Enemy No. 1...
DUST
DUST ON IT'S WINDINGS "BLANKETS" A MOTOR WITH A LAYER OF INSULATION.
A HANDFUL of sand thrown into wheat by Mother Nature
Electric Motor Enemy No. 2...
STRAY OIL
OIL IS QUICK TO ATTACK INSULATION WHEN IT REACHES IT.
Electric Motor Enemy No. 3...
MOISTURE
HEAVEN for a motor must certainly would be a dry place. And while it is impractical to keep motors completely dry in many installations, that nevertheless should be one general aim of effective
that much more time to absorb harmful compounds and become an active, destructive agent.
How to Fight it...
Every effort should be made to keep water in liquid form from dripping
Electric Motor Enemy No. 4...
FRICTION
IN THEORY, no wear can take
being moved and the floor under it.
Electric Motor Enemy No. 5...
MISALIGNMENT
ONCE MISALIGNMENT STARTS 'EM FIGHTING EACH OTHER...
Electric Motor Enemy No. 6...
VIBRATION
VIBRATION SHAKES THE LIFE OUT OF MOTORS
Electric Motor Enemy No. 7...
UNEVEN WEAR
YOU EXPECT WEAR AT SOME POINTS...
(TIRES ON A CAR)
ON SLIP rings and commutators of electric motors, wear is accepted as inevitable—just as it is on the tires of a car. The reason, of course, is that none of these rotating parts exposed to constant friction can be fabricated with petroleum products.
But just as tire wear can be minimized by switching tires around to keep tread wear even—so the wear on commutators and slip rings can be minimized by preventing conditions leading to 'grooving' (concentration of wear in narrow rings or cuts).
Electric Motor Enemy No. 8...
OVERLOAD
LIKE AN OVERLOADED HORSE, A MOTOR WORKED BEYOND IT'S HORSEPOWER CAPACITY IS SURE TO BREAK DOWN.
TODAY, in a world of war, the
Electric Motor Enemy No. 9...
UNDERLOAD
ALTHOUGH the penalties are less severe, underloading an induction motor is just as clearly improper as overloading it.
As indicated below, the total current flowing in an a. c. circuit is made up of two components: (1) "real (useful) power"—that produces mechanical energy—and (2) "wattless current"—that produces merely the magnetic field required in induction motors.
It is characteristic of induction motors that when they are working under only part load the proportion of wattless current is INCREASED.
Technically the "power factor" (ratio of real power to total power) is lowered.
Comparing total or apparent power to a man of a given size, we see that wattless current is like fat—real power like muscle. The more of one, the less of the other.
And because there is a limit to the power capacity of generators, transformers and power lines, the character or quality of the total power is of prime importance.

ALL NINE electric motor enemies are present and accounted for in Allis-Chalmers' new "Guide to Wartime Care of Electric Motors." Streamlined instructions and story-telling pictures describe what they are, where they're found, how to fight them.

Designed for wartime U. S. industry, "Guide to Wartime Care of Electric Motors" has aroused such world-wide demand that Spanish and Portuguese editions are now printing!

You'll find this valuable new handbook ideal both for training new men and "brushing up" old hands. It contains no advertising. Write today for *your* free copy of this tremendously successful handbook to ALLIS-CHALMERS MFG. CO., MILWAUKEE, WISCONSIN. A 1625

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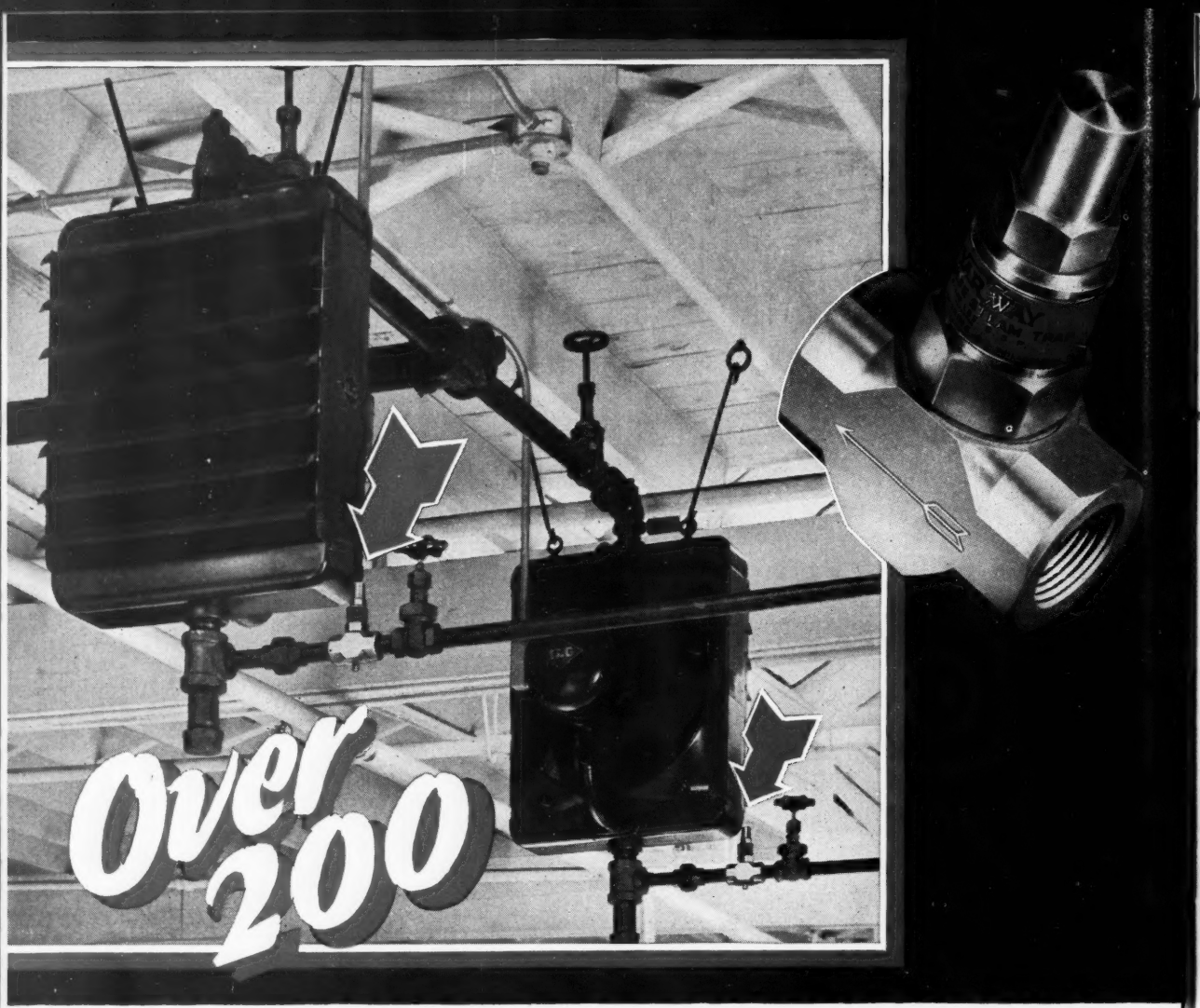

YARWAY IMPULSE TRAPS
Serve Landers Corporation

THE Landers Corporation, of Toledo, Ohio, manufacturers of artificial leather, say: "We first started using Yarway Impulse Traps six years ago because we needed a trap that would be *efficient at all steam pressures* in the mill *without adjustment or change of parts.* Soon after we started using them we found that Yarway Traps could *heat up our coils twice as quickly* because they could *handle air in large quantities.* Today, we have over 200 Yarway Impulse Traps on all kinds of services."

Real satisfaction in service needs little further comment except that this is a typical experience of users who have purchased more than 200,000 Yarways to date. *So easy to install; small size; quicker heating and greater sustained heating efficiency; low cost, often less than repairing old traps,* are other reasons why you should standardize on Yarway Impulse Traps.

See your Mill Supply Dealer or write for Bulletin T-1737.

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YARWAY IMPULSE STEAM TRAP

WHAT LEADERS SAY

Wartime Science and the Engineer

By HAROLD V. COES

THE HARD, INEXORABLE pressure of the war's necessities is compressing into a few short years, sometimes even into a few months, research and development work that under normal peacetime conditions is spread over years, sometimes a generation or more, before the public begins to benefit extensively by the work.

I am not thinking so much about the marvels of production, a gripping story all its own, as I am about what we engineers are being confronted with from the scientists' Pandora's box—the results of scientific research and development.

There is every likelihood that postwar we will have aluminum at 9 or 10 cents a pound, with all that that implies, and capacity to produce in one year enough aluminum material to build three times the number of passenger cars now operating on all American railroads; or by the end of 1943, seven times our 1939 aluminum production, and this after 50 yr of intensive development, as pointed out by Dr. Charles M. A. Stine.

Dr Stine further staies, "We will probably have more aluminum and magnesium capacity than copper and zinc capacity after the production facilities are completed."

New alloys with tensile strengths of 190,000 psi are emerging. New ferroalloys may permit the use of temperatures up to 1100 F in power plants and chemical processes. If we find a way to produce beryllium more cheaply and can produce nickel beryllium alloys commercially, products can be obtained that are highly resistant to fatigue under repeated stress and a whole new sector is opened up for mechanical design. Two per cent of beryllium mixed with copper increases the tensile strength to 185,000 psi and renders the alloy heat treatable. Two per cent of beryllium mixed with nickel raises the tensile strength of the alloy to 260,000 psi.

Just consider what these new structural materials, with plastics, aluminum, magnesium, synthetic rubber and high octane gasoline will do to just the automobile industry alone.

The completion of another huge plant for the production of 100 octane aviation gasoline is one more step nearer the day when all our planes will be able to carry still greater loads.

I understand that a large plane operating on 100 octane gasoline can carry approximately 5000 lb more load than with 87 octane.

The chemists have already produced gasoline with higher than 100 octane rating. Fuels can now be made of 115 rating (better than the best) which produce 50 per cent more power than at 100 rating, so the indications are that our fuel technology has already outstripped our mechanical technology in engines and accessory designs. Consequently new engines and new materials to withstand much higher mep's are much to the fore.

Development of a new plastic has been recently announced by Dr. James M. Church of Columbia University. This plastic, styled thermo-cast, possesses a unique property that permits it to be melted and cast into shapes, without the use of pressure, similar in this respect to cast iron, but with greater exactness of mold dimensions. Its strength characteristics rival those of some steels, in many respects, but its weight is only one-fifth that of steel.

David Sarnoff recently stated that micro-waves can be used to heat, dry, glue, starch, anneal, weld and rivet. They can laminate an airplane propeller in minutes compared to hours required by ordinary heat and pressure methods. Radio high frequency furnaces are a postwar prospect. The possibilities for very sensitive control devices through the application of electronics are wide.

A General Electric engineer recently stated that there are more than 40 portable million volt x-ray units available in industrial plants making war materials. A year ago there was only one such unit in industry. Accelerated application of x-rays to industrial inspection needs for welds, large castings, examination of production equipment to keep it operating or to forestall serious breakdown, is something to ponder over.

No one begins to know what new fields of knowledge will be opened up by the electron microscope.

New lubricants and lubrication methods are being evolved and developed for war purposes. These will have a far reaching effect on design.

What about the possibilities for new sources of power? Atomic power? Some chemists and physicists are doubtful, stating that uranium is available in only small quantities. Others do not share this view. They believe that the principle of the release of power by atomic disintegration may yet be applied to other more plentiful elements, furthermore that uranium may be discovered in much larger quantities.

The development in powdered metallurgy is something for engineers to watch.

We cannot turn back from the new developments of scientific research, even if we want to. Their impact on engineering design and application will be tremendous and we engineers should be prepared for it. Our old preconceived ideals will be jolted, to say the least. We need to be alert, receptive, open minded, tolerant and imaginative. These are engineers' characteristics.

I look upon these new developments as a rare opportunity to progress, to develop, to raise the standard of living. So let us accept these developments as a means for engineers to aid in supplying one of the bases for a better life. The only way it can be provided is by work, greater production and thereby the creation of wealth. We have proved we can do it in wartime. Let us turn our talents and the application of these new developments to the peacetime economy when it is time to do so.

Harold V. Coes, president of the American Society of Mechanical Engineers, is vice-president of the engineering firm of Ford, Bacon & Davis, Inc., of New York. He was born in Hyde Park, Mass., and was graduated from Massachusetts Institute of Technology in 1906.

He became associated with Ford, Bacon & Davis, Inc., during the last year of World War I. In 1937 he became a partner of Ford, Bacon & Davis, Inc., and in 1941 was made vice-president.

Mr. Coes has been an active member of the ASME since 1907; he is a former manager and former vice-president of the Society, has served on many important committees and is now the Society's representative on the Engineers' Defense Board. The material presented here is an abstract of a speech delivered at the Annual Meeting and Presidents Night, Chicago Section, ASME on April 28.

(Acme)

HEADACHE IN TUNIS

THIS photograph of the bomb-wrecked interior of a power station in Tunis shows what a successful aerial attack does to a power station. It is pretty much of a shambles. This destruction was caused by our own Allied raiders who pounded the city while it was still in Axis hands. Note the attempt to protect the generating units from damage by the sandbag barricades; they do not appear to have been very effective. We wonder where the turbine of the generating unit near the center of the picture disappeared to; it seems to have vanished completely, casing, diaphragms, rotor blades and all. If anyone over here thinks they are having a hard time of it trying to keep a plant running under wartime conditions, what would they do if they awakened some morning with a headache like this? New turbines must be rather scarce in Tunisia these days. ¶ Though it is now our mess to clean up we can derive satisfaction from this picture because it is a good example of Allied marksmanship. Although the bombers passed over the city repeatedly, the city itself was left practically untouched. Military objectives, however, such as this power station, suffered heavy damage. ¶ This picture lends emphasis to the facts mentioned in Bill Maddock's article on bomb-proof construction of utilities appearing on page 69 of this issue. Mr. Maddock points out that there is a difference between bomb-proofing and bomb-resisting structures. Only those structures which are built entirely underground, often by the use of mining methods, are really bomb-proof.

WITH THE EDITORS

◆ **IRRITANT** — One of the less-known irritants originating in our nation's capital that is giving certain people and groups of people a lot of headaches these days is a certain bill now pending in the United States Senate, known as the Kilgore Bill. This bill (S 702) introduced by Senator Harley Kilgore of West Virginia is little known to the public but it has drawn the ire of an emphatic and outspoken group of trained personnel both within and outside of government circles. The Army, officially, and the heads of existing technical agencies and big industrial laboratories together with certain technical societies and trade associations oppose the bill to a unit. This group includes men like Dr. Frank B. Jewett, head of Bell Laboratories and President of the Academy of Sciences, Dr. Gustav Egloff of Universal Oil Products, Dr. Harvey Davis of Stevens Institute of Technology. They do not want the Kilgore Bill passed.

On the other hand, there is a less cogent but nevertheless outspoken array of individuals who rather favor the bill. This group includes, with reservations, men like Donald Nelson, Henry Kaiser, William Jeffers, Aircraft Pilot Hiram Sheridan, and thousands of small individual inventors, from Maine to California.

The Kilgore Bill seeks to establish a Federal Office of Scientific and Technical Mobilization. If passed, the measure would give the Office the power to draft technical men, initiate research, contract for prototypes and pilot plants, acquire patents and coordinate all government technology. It would promote the establishment of standard specifications and design, and (in time of war only) would requisition, for "fair compensation," patents and technical facilities vital to the war effort which could not otherwise be secured. Such facilities would be returned six months after the war.

◆ **PURPOSE**—The purpose back of the bill is more effectively to coordinate the technical and scientific resources of the nation for the good of the nation as a whole, especially in war. The nation, according to the proponents of the bill, has a vast reservoir of scientific knowledge, of technically trained manpower and of scientific and technical facilities. This wealth, they claim, according to overwhelming testimony presented before the Senate Military Affairs Sub-Committee on Technological Mobilization, has not been used fully in the national interest during this war. Scientists and technologists, they say, as individuals and as representatives of institutions and industries, have been ready and willing to serve the war effort and many have made significant contributions but far more have not been able to apply their talents in the most effective way. The establishment of the Office of Scientific and Technical Mobilization would be empowered to institute measures to prevent this waste of manpower and material.

◆ **OPPOSITION**—So much for the bill and its purpose. The opposition to it stems from many interests. The Army, aside from its real fear that the bill's powers would encroach on its right to select its own weapons, is simply against the whole idea. Industry in general seems to be against it because it fears further government encroachment on, and the destruction of, the system of free enterprise. The big industrial laboratory heads feel that it would kill private research and that forced drafting of technical personnel would be nothing short of coercion. While they admit the stated objective of the bill to be wholly praiseworthy, they insist that it is based on false premises. Furthermore, they claim it (the bill) to be mischievous in its implementation, undemocratic in its methods, unfair and confiscatory in certain of its provisions and potentially destructive in its results. They don't want any part of it.

The preamble of the bill calling attention to the lack of coordination of our technical resources, the opponents of the bill claim, seems to have been written in ignorance of the existing agencies for mobilizing the nation's technical resources and of what has been accomplished by their effective mobilization. Like the mobilization of industry, they admit, it has not been perfect but for the same two reasons, i.e., that no agency is perfect and that the task is of gigantic magnitude, but also, as in the mobilization of industry, the achievements have been great and the results impressive. They back this assertion with a splendid array of facts regarding the work of various agencies.

To supersede these existing agencies, now doing good work in each field, by a new, all-inclusive and inexperienced authority, the opponents claim, would be utterly mischievous. Present programs would be upset and entangled in red tape, new questionnaires, new contracts, etc., would result in vast useless labor and disastrous delay and with little likelihood of accomplishing as much in the end as is now being accomplished. If there are defects in the present set-up, they should be cured by improving and strengthening existing agencies. We should not tear down and rebuild the house merely to cure a few minor defects.

On the whole, the opponents of the Kilgore Bill are able to marshal an imposing array of arguments in support of their opinions regarding the bill. Many of them have considerable merit. Whatever the shortcomings of the present system, it does seem illogical to propose to scrap the whole system in order to correct these shortcomings. Offhand, it would seem much more logical to make an honest attempt to more effectively coordinate our present set-up of interests and agencies to bring about a unified whole.

◆ **IN FAVOR**—On the other side of the picture are the thousands of independent inventors and small technical groups whose lost and shelved ideas and plans never had or will have a chance of bearing fruit under the existing set-up. There are dozens of these lost ideas around Washington but countless others never even reach the Capitol. These, as "Fortune" put it recently, are the lost cries from Portland, Tulsa, and the great fertile reaches of the country. This is the area of the smaller technical group, the smaller college researcher, the individual inventor—the man whose only contact with the outside is through a mailbox. Organized research disposes of the cries of this group with the assertion that the top industrial and university laboratories can handle everything and that there is really not much to be done outside. History refutes this. True, the bulk of invention has come from the big laboratories but enough developments have originated on the outside and made their way to the top by sheer force of their merit to prove that there is something in the claims of the less vocal group. Short wave radio is an excellent example; many of the developments in this field came not from the big laboratories but from the independent amateur working for the love of the game.

◆ **WARNING** — Whatever action is taken on the Kilgore Bill—the chances are that it will not be enacted into a law in its present form—it is a warning. The Bill points to a need and if this need is not satisfied in the ordinary course of development something like the Kilgore Bill may find its way into legal existence. In its present form the bill is primarily an antimonopoly measure and this conditions people's opinions about it. Aside from other considerations, the magnitude of the undertaking inherent in the bill is appalling. To direct the work of hundreds of thousands of scientists, engineers and technicians, to select the most urgent projects and assign each individual to the task he can best perform, to organize them into efficient teams, to provide the necessary facilities, to follow all programs closely enough to make the changes, additions, or reductions which changing conditions require, to guide research developments from the research stage through engineering design and quantity production and to their effective use in the field would demand, as one noted scientist put it recently, nothing short of omniscience and omnipotence.

For these and other reasons the passage of the Kilgore Bill should be opposed, but within and without the political nature of the bill are many real problems that must be worked out in a democratic way if we want to make the fullest and most effective use of our technical and scientific resources. Something else should be provided. In the absence of that "something else" there are many people in this country with a deep faith in the inventive genius of America and with a not too high regard for what they feel are the vested interests of the big laboratories who would be inclined to favor the Kilgore Bill or some counterpart of it. A. W. K.

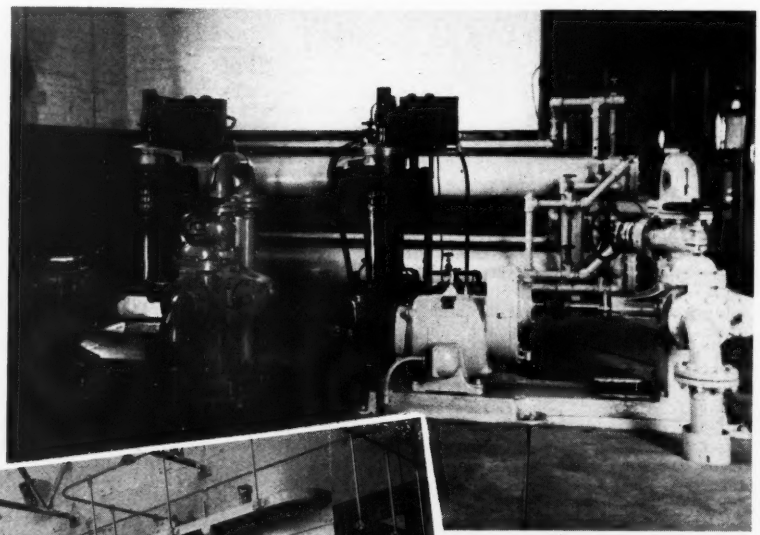
The New Diesel Plant At Rushville, Ind.

By GLENN C. BOYER
Associate Engineer
Burns & McDonnell Engineering Company

PROBABLY the last completely new power plant using diesel engines for prime movers to go into operation before wartime restrictions stopped this type of construction is that of the Southeastern Indiana Power Company. Located at Rushville, Indiana, the plant with an installed generating capacity of 6480 kw, supplies power to communities, farms, REA projects, and industrial consumers in 11 contiguous counties. It went into operation in October, 1942.

Power was formerly purchased wholesale by the company. A study of the costs of generating or purchasing the energy required indicated that the more economical method was to generate the power required. Before the type of plant was determined, extensive studies of steam as well as diesel-driven generating units were made together with examinations of the physical plant and operation of numerous generating stations throughout the United States. The final decision was to install diesel-engine driven generating units.

The original construction program contemplated the installation of four generating units, each of 2160 kw capacity, and a contract was awarded to the Busch-Sulzer Bros. Diesel Engine Co. in March, 1941, for the four generating units. Before the fourth unit was installed in the plant, the War Production Board found it necessary to divert this unit elsewhere. As a result, only three units are now installed instead of the four originally con-



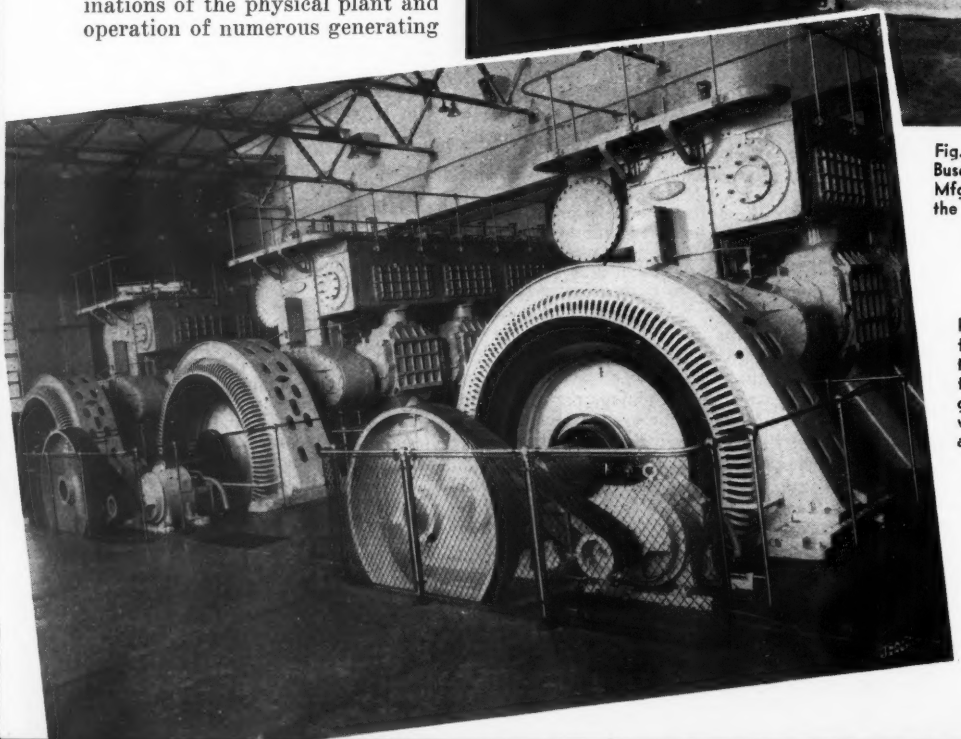


Fig. 1. (Left) The three 2160-kw Busch-Sulzer Electric Machinery Mfg. Co. generating units give the station a total installed capacity of 6480 kw

Fig. 2. (Above) A view of the fuel oil heaters and centrifuges. From the centrifuges the oil is delivered to a 10,000 gal underground tank equipped with hot water heating coils and temperature regulating valve

Fig. 4. The automatic air filters, exhaust boiler silencers and hot air heating fan in the auxiliary room

templated. Switchgear, piping, cooling water pumping capacity, and the necessary foundation for the fourth unit have all been provided in the existing installation.

During the first five months of operation an average of 14.3 kwhr were produced for every gallon of fuel oil consumed. Furthermore, the power used for station auxiliary power and lighting averaged only 1.4 per cent of the gross generation.

Each prime mover has a full-load rating of 3060 bhp and is directly connected to a 2700 kva, 2160 kw, 4150 v, alternating-current generator. Excitation is supplied by individual V-belt driven exciters. Each engine is a 9-cylinder, two-stroke cycle, trunk-piston unit with mechanical fuel injection equipment arranged for low-gravity, high-viscosity fuels. The bore is 20½ in., the stroke 27½ in., and the rotative speed 240 rpm. Full-load brake mean effective pressure is 61.8 psi.

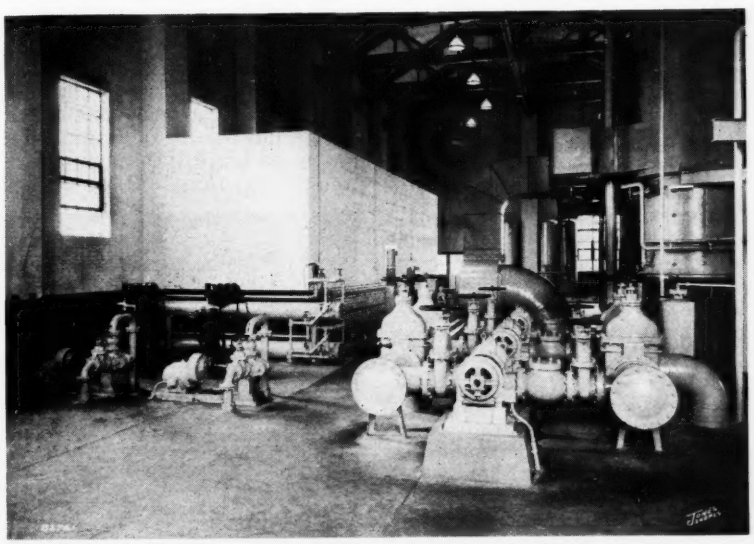


Fig. 3. The auxiliary room showing the fuel unloading and centrifuging equipment, jacket water pumps and the enclosure housing the lubricating oil purifier and fullers earth supply

Generators and exciters were built by the Electric Machinery Manufacturing Co. with the necessary flywheel effect incorporated in the generator rotor. Each generator is provided with an individual voltage regulator.

The company owned a power plant building which formerly housed 25-cycle generating equipment serving an interurban traction system, although the equipment had been removed some years ago. This building was found to be suitable for a diesel plant. Sufficient space was available for housing five diesel units together with the necessary auxiliaries and it was reconditioned to accommodate the new installation. Engine foundations were set on a common reinforced concrete mat and the entire structure isolated from the building to eliminate possible vibration transmission. The engine room floor between engine foundations is made integral with the foundations. A new 15-ton electrically operated hoist was provided for the original crane installation.

The building is of steel frame and brick construction and is divided into three sections comprising an engine room, auxiliary room, and switchgear room. The engine room floor level is approximately six feet above ground. A full basement is provided in the building.

Cooling Water

Cooling water for the plant is obtained from a mill race formerly used for the steam installation. Water flows by gravity through a tunnel to the raw water pumps. The three pumping units, each rated 1650 gpm at 30 ft head, are installed in a reinforced concrete pit in the east end of the station auxiliary room at an elevation below the level of the mill race. The pumps discharge into a common header from which branches are run to each engine oil cooler and heat exchanger, as well as to the plant water softener. From the heat exchangers, the raw water discharges into a weir chamber installed in the discharge tunnel to the mill race. An emergency city water connection is provided into the raw water header.

The jacket water system is of the closed type with headers having connections to each engine. A surge tank is connected to the common engine discharge header and absorbs the expansion of the jacket water due to temperature changes. The available water is hard, and during some seasons, muddy. A sand filter and softener are installed to supply clean soft

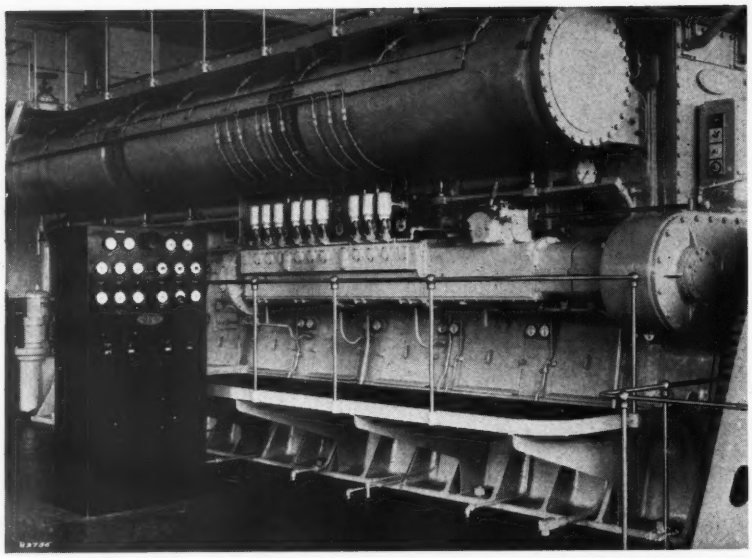


Fig. 5. One of the engines showing the fuel injection pump and gage alarm cubicle

water for the jacket cooling and plant heating systems. The softener discharges directly into a combination makeup and drain tank located in the basement. Makeup water is pumped from this tank either to the jacket water or hot water surge tank. Automatic control is provided by the use of magnetic valves actuated by float switches in these tanks. Three jacket water pumps, each rated 1400 gpm at 40 ft head are installed. In designing both the raw and jacket water systems, pipe friction losses were kept low in order to reduce the power required for pumping to a minimum.

All heating requirements, with the exception of that necessary for fuel unloading in severe weather, are supplied by the engine exhausts. Each exhaust snubber is equipped with a fire-tube type hot water boiler section incorporating an output control. This control regulates the output of the boiler with respect to the heating demands and ambient temperature variation. Hot water is used to heat fuel oil in outside storage tanks, lubricating oil in outside storage tanks, fuel oil before centrifuging, and fuel oil before entering the engine fuel pumps. It is also used for heating the locker room and office and for heating city water used in the shower and lavatory. Hot water is circulated to the various services by a motor driven pump. A duplicate emergency hot water pump is also installed. In addition to the hot water boiler section, each snubber is equipped with a sheet metal jacket around the silencing chamber. Air is circulated through these jackets by a forced draft fan to provide hot air heat for engine and auxiliary rooms. Circulation is not required during the spring and fall while during the summer months the hot air is discharged to atmosphere by means of outlets through the roof for air conditioning the engine and auxiliary rooms.

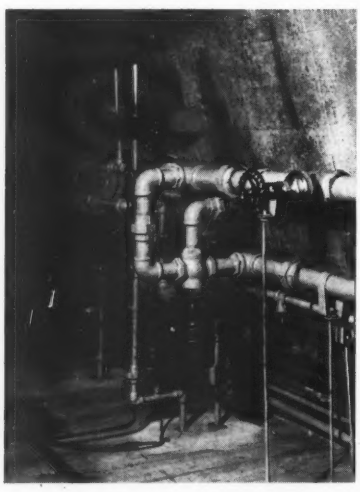


Fig. 6. Engine fuel oil heater and automatic temperature control valve

Fuel Oil

In case it is necessary to purchase and unload fuel during the winter, steam is needed for heating tank cars containing high-viscosity oil. To meet this demand for steam if necessary, a small oil-fired steam boiler was installed in the west end of the auxiliary room. Water for operation is obtained from the engine jacket surge tank, while fuel oil is taken from the station supply. Under ordinary operation this boiler will be rarely used since sufficient fuel storage is provided for an entire winter's operations.

The main fuel oil storage consists of two 12,500 bbl vertical steel tanks built to American Petroleum Institute specifications. Each tank is equipped with a hot water suction heater, steel tape level indicator and screened vent. Fuel is unloaded from tank cars or trucks and delivered to these tanks by two rotary pumps, each of 100 gpm capacity. Four tank car and one truck unloading stations are provided. Fuel flows from these tanks to two centrifuges where it is cleaned and then is delivered to a 10,000 gal underground tank, equipped with a hot water heating coil and temperature regulating valve. Heating for centrifuging is accomplished through the use of two shell and tube type heaters. Fuel is pumped from the underground tank to the engine day tanks as required by rotary motor driven pump, controlled automatically by flat switches and magnetic valves. Fuel metering is accomplished by temperature-compensated meters installed in the fuel lines to the respective day tanks.

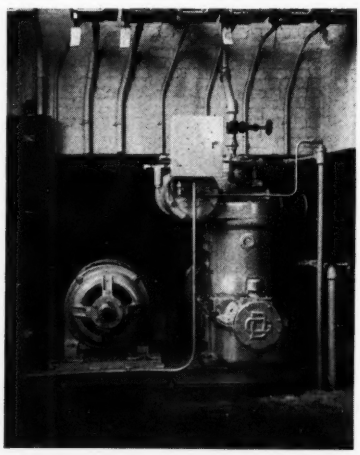


Fig. 7. The motor driven air compressor

Light fuel oil is used for starting and stopping the engines to keep lines from congealing. This fuel is stored in a 15,000 gal underground tank and its transfer to the station is automatic.

Lubricating Oil

Lubricating oil, purchased in tank car lots, is stored in a 15,000 gal, two-compartment underground tank, one side for bearing

oil and the other for cylinder oil. Both compartments of this tank are equipped with hot water heating coils. Lubricating oil is transferred from these compartments directly to the engines by individual motor driven transfer pumps. Measuring is accomplished by calibrated level gages on the engine tanks.

A complete system for purifying the lubricating oil has been installed consisting of a Youngstown-Miller purifier, together with the necessary transfer pumps and piping systems. The arrangement of conditioning facilities permits either bearing oil or cylinder oil being reclaimed and returned to the engines or to the outside underground storage tank. The purifier is also arranged so that transformer oil may be reclaimed when necessary.

Particular attention was paid to the meters and instruments required for operation of the plant. Engine instruments and alarms are mounted on a cubicle set on the operating floor at each engine. All instruments are readily visible both from the operating floor and the engine operating platform. A central cubicle is installed for push-button switches required for the operation of all motor driven auxiliaries as well as instruments common to all plant operation. Provision has been made for remote reading of the levels in all outside underground storage tanks so that it is not necessary to go outside to gage these tanks.

FUEL CONSUMPTION GUARANTEES*

LOAD	1/2	3/4	4/4
Fuel Consumption			
Lb per hphr....	0.40	0.37	0.37
Lb per kwhr....	0.574	0.526	0.523

*Fuel consumption guarantees based upon 19,000 Btu per pound fuel gross heating value.

Air filters are of the Automatic Continuous type, installed in steel housings located in the auxiliary room. Air is piped to each air filter housing from a point above the auxiliary room roof. These self-cleaning filters are operated automatically. Only periodical attention to the viscosine reservoirs is necessary.

Electrical Features

Power is generated at 4160 and stepped up by transformers to 34,500 v in an outdoor substation for delivery to the distribution system. The indoor switchgear consists of an eleven panel cubicle-type control board and nine metalclad "DE-ION" air circuit breaker units. Two of the control panels are used for station metering and control of the substation breakers. The balance of the control panels together with the metalclad circuit breaker units provide for two 4160 v feeders supplying the substation, two station service feeders, four generator circuits and one bus sectionalizing circuit. The control is located adjacent to the generators while the circuit breakers are installed in a separate room.

The 4160 bus is sectionalized—each half connecting two generator circuits, one substation feeder circuit and one station service circuit. The other half of the bus is identical. This arrangement insures continuity of service at all times while providing for maintenance or additions to be made on a "cold" bus.

Two station feeders each connected to a 300 kva 4160/480 v station service transformer are provided—one being a spare. Preferred and emergency control is utilized to insure auxiliary power at all times. The 480 v station power is distributed from a single metalclad distribution panel, through a Trumbull Flex-A-Power distribution feeder located on the auxiliary room wall and extending the entire length of the plant. Plant auxiliaries are connected into this feeder at the most convenient points throughout its en-

(*Continued on Page* 118)

LIST OF PRINCIPAL EQUIPMENT INSTALLED AT RUSHVILLE

Diesel Engines	Busch-Sulzer Bros.-Diesel Eng. Co., St. Louis, Mo.
Crankshafts	Erie Forge Co., Erie, Pa.
Engine Lubricating Pumps	Schutte & Koerting Co., Philadelphia, Pa.
Governors	Woodward Governor Co., Rockford, Ill.
Generators & Exciters	Electric Machinery Mfg. Co., Minneapolis, Minn.
Switchgear & Switchboard	Westinghouse Electric & Mfg. Co., E. Pittsburgh, Pa.
Transformers & Substation	Westinghouse Electric & Mfg. Co., E. Pittsburgh, Pa.
Mufflers, Waste Heat Boilers & Silencers	Burgess Battery Co., Chicago, Ill.
Air Filters	American Air Filter Co., Louisville, Ky.
Air Compressors	Gardner-Denver Co., Quincy, Ill.
Fuel Oil Centrifuges	Sharples Corp., Philadelphia, Pa.
Fuel Oil Filters	Purolator Products, Inc., Newark, N. J.
Fuel Oil Meters, Strainers & Air Releases	S. F. Bowser & Co., Inc., Ft. Wayne, Ind.
Water Meter	Worthington-Gamon Co., Harrison, N. J.
Fuel Oil Heaters	Ross Heater & Mfg. Co., Buffalo, N. Y.
Thermostats for Fuel Heating Control	The Powers Regulator Co., Chicago, Ill.
Lubricating Oil Coolers	Ross Heater & Mfg. Co., Buffalo, N. Y.
Lub. Oil Purifier	Youngstown-Miller Co., Sandusky, Ohio
Oil Transfer Pumps	Yale & Towne Mfg. Co., Stanford, Conn.
Gear Head Motors for Oil Transfer Pumps	Master Electric Co., Dayton, Ohio
Oil Storage Tanks	Graver Tank & Mfg. Co., Inc., E. Chicago, Ind.
Underground Pipe	The Ric-Wil Co., Cleveland, Ohio
Jacket Water Heat Exchangers	Ross Heater & Mfg. Co., Buffalo, N. Y.
Water Pumps	Dayton-Dowd Co., Quincy, Ill.
Hot Water Pumps	Micro-Westco, Inc., Bettendorf, Iowa
Steam Heating Boiler	Kewanee Boiler Co., Kewanee, Ill.
Oil Burner	Ray Oil Burner Co., Los Angeles, Cal.
Water Softener and Sand Filter	The Permutit Co., New York, N. Y.
Hot Air Heating Fan	B. F. Sturtevant Co., Boston, Mass.
Control for Hot Air Fan Motor	Cutler-Hammer, Inc., Milwaukee, Wisc.
Dampers for Hot Air Heating System	The Powers Regulating Co., Chicago, Ill.
Aux. Motors & Control	General Electric Co., Schenectady, N. Y.
Magnetic Valves	Alco Valve Co., St. Louis, Mo.
Float Switches	The Mercoid Corp., Chicago, Ill.
Pyrometers & Thermocouples	Illinois Testing Laboratories, Chicago, Ill.
Pres. Gages & Thermometers	Jas. P. Marsh Corp., Chicago, Ill.
Main Fuel Storage Tank Level Gages	The Viking Pump Co., Cedar Falls, Iowa
Other Tank Level Gages	The Liquidometer Corp., Long Island City, N. Y.
Indicator & Indicator Valves	Bacharach Industrial Instrument Co., Pittsburgh, Pa.
Hoist	Shepard Niles Crane & Hoist Corp., Montour Falls, N. Y.
Generator & Substation Power Cables	Kerite Insulated Wire and Cable Co., New York, N. Y.
Station Control Cables	General Cable Corp., New York, N. Y.
Plant Lighting Fixtures	The Holophane Co., New York, N. Y.
Station D-C Batteries	The Philco Co., Philadelphia, Pa.
Rectox Battery Charger	Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.
Flex-a-Power Bus Duct	Trumbull Elec. Mfg. Co., Plainfield, Conn.

A New Armature Winding Diagram

Part III

Having explained the fundamental principle of his winding diagrams in Part I and the method of extracting winding data from them in both Part I and Part II, the author now proceeds to a more detailed analysis of chorded windings and their interpretation by means of these diagrams. The vast majority of armature windings are either of the fractional pitch type or the fractional slot type so this application of the winding diagram to this class of armature windings should prove particularly useful to practical operators

By WILLIAM T. TAYLOR

FRACTIONAL pitch or *chorded* windings have the advantage of eliminating or reducing space harmonics in the field form, also eliminating tooth harmonics, securing better ventilation owing to air space left between the end connections, reducing the exciting reactance and magnetic noise as well as magnetic locking. The effects produced by chording the winding are somewhat similar to reducing the length and/or the number of active conductors, but chording has the advantage over actual conductor reduction. By chording the winding, the normal phase-belts are broken up and become narrower thus reducing the size of current and flux distribution-steps as also the change from instant to instant, which reduce the variations and smoothes out quantities such as current, magnetomotive force and gap flux.

If two or more coils lie in the same identical positions in the magnetic field their vectors will coincide, the same phase-belt positions will recur under every pole, and the magnetic flux will divide into as many magnetic circuits or pole-zones as there are poles in the winding depending upon the number of slots occupied by each coil and by the total number of slots in the core. The amount of magnetic flux will depend upon the number of turns of wire in the coils since the magnetizing power of a coil is directly proportional to the number of turns it contains, the number of coils in series, the coil throw, and the current carried.

A coil throw differing from full pitch may be made either to permit of a consequent-pole connection or to improve or modify the magnetic field and voltage. Under other than full-pitch conditions a machine is endeavoring to maintain the field strength at maximum value since one of the coil sides is at that value, i.e., one coil side (the top coil side which is at the full-pitch pole zone boundary position) is actually in the position of maximum field strength whereas the other coil side of the same coil (the bottom coil side which is at the chorded pole zone boundary position) occupies a different position in the magnetic field and in that position it is attempting all the time to maintain a greater magnetic field strength than the position of the coil side is capable of developing; that is to say, being displaced, it is endeavoring to pull itself into place. More current has to pass through the coils if the equivalent full-pitch field strength is to be provided, and if there is not sufficient iron behind the slots to carry the flux, excess temperature may result. Only when the coils span a full pole pitch will the magnetic field strength and area be at maximum value.

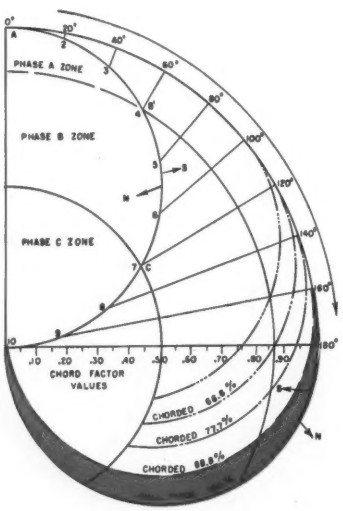


Fig. 1. Showing one complete magnetic pole zone of a 3-phase, 4-pole, 36-slot machine with chordings down to 55.5 per cent of the windings. Note the chord factor values not hitherto shown in any armature winding diagram. This is an enlargement of the top right section of Fig. 2

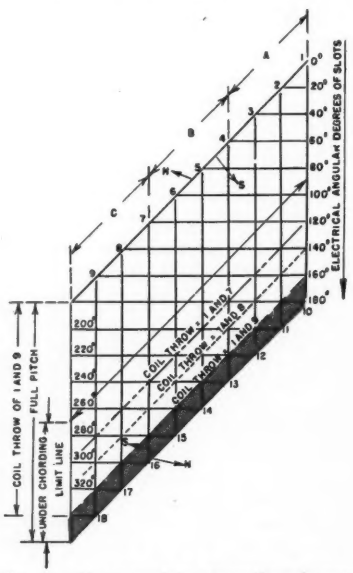

ELECTRICAL ANGULAR DEGREES OF SLOTS
COIL THROW OF 1 AND 9
FULL PITCH
UNDER CHORDING LIMIT LINE
COIL THROW 1 AND 7
COIL THROW 1 AND 8
COIL THROW 1 AND 9

Fig. 1a. One complete magnetic pole zone of a 3-phase, 4-pole, 36 slot machine with shortened coil throw down to 1 and 7

As chorded winding diagrams shown herein are based on integral-slot full-pitch layout they can be used for both full-pitch and fractional-pitch conditions. There are a certain number of slots per pole which belong to a certain phase and zone, and, for a full-pitch winding these slots and phases belong to fixed positions in the field such that top and bottom coil-sides belong normally to the same phase zone, hence the currents flowing through each slot are in the same direction. Not so the chorded winding hence we require to know (preferably visualize) what coil side and by how much each coil side or/and what phase belt has been overlapped by another and what other and where, all of which should be known and is actually

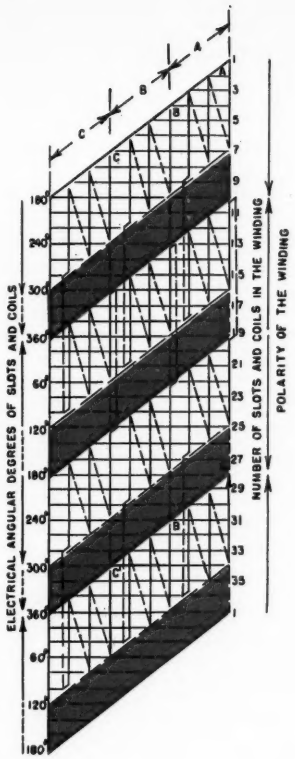


Fig. 2 (Left). A fully developed 36 slot and coil, 120 deg chorded (1 and 7 coil throw), 3-phase, 4-pole lap winding

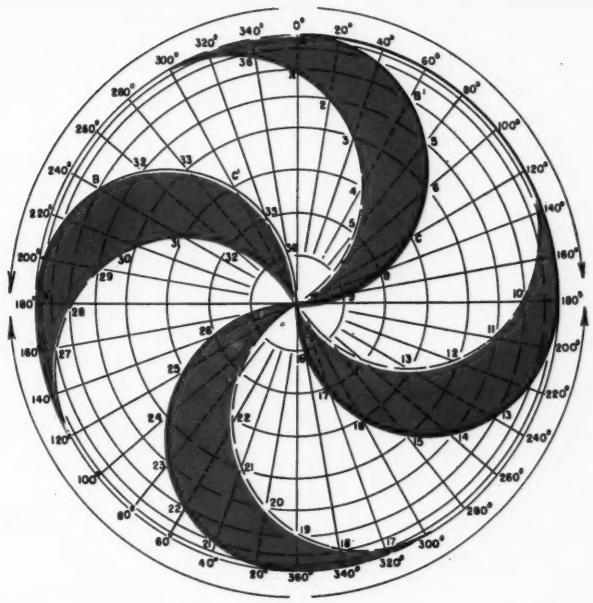


Fig. 2a (Above). A basic layout for a 36-slot and coil, fractional-pitch (120 deg chorded) 3 phase, 4-pole machine. Fig. 1 is an enlargement of the top right section shown in heavy outline

visualized in this form of diagram. Moreover, the actual chord or pitch factor is visualized as well; in fact the polar or sine-curve diagram comes into its own when used for chorded windings.

The vast majority of armature windings are either of the fractional-pitch type or fractional-slot type, hence there is more justification for discussion of these types than the much less used full-pitch integral slot type referred to in Parts I and II[1].

Rules laid down in Part I for the full-pitch lap winding are the same for this class of winding except that, as a fixed rule, the top coil-sides may be regarded as being "fixed" or keyed to the full-pitch pole zone boundaries so that any difference in winding procedure rests entirely with the chorded pole zone boundaries. And for a one or more slot-pitch displacement from the full-pitch position, the chorded winding diagram may be read as follows:

(1)..For chorded span of coil proceed from a full-pitch pole zone boundary to a chorded pole zone boundary.

(2)..The full-pitch pole zone boundary position is a top coil-side and the chorded (fractional pitch) pole zone boundary is a bottom coil-side.

(3)..Group-to-group connections and coil-to-coil connections follow the same procedure given in Part I.

Note: There is something wrong if the readings for (1) and (3) are *not* on the same vertical line or circle, as the case may be. Hence, like full-pitch windings, this is a definitely reliable connection checker and a guarantee against wrong group-to-group connections.

Both lap and wave windings adhere to equi-potential groups or coil connections and phase-zone groupings. The double or 2-layer connected windings particularly deserve study. They are universally the most popular of all windings used in polyphase induction motors and they are the most adaptable to conditions such as full-pitch, fractional-pitch, fractional slot and unequally grouped coil as well as cut-out arrangements, one or more parallel operation, two speed changes and phase changes, etc. The lap winding adheres strictly to coils of equal span and shape, and distinct phase zones per phase group, and it is the most flexible and most adaptable of all armature windings.

By the polar or sine-curve method, Fig. 1 shows one complete magnetic pole between N and S boundary lines, and Fig. 1a shows the equivalent magnetic pole field area by the straight-line method. The complete winding layout (a 36-slot and coil 3-phase 4-pole) is shown in Figs. 2 and 3. The color portion of the field area is that part chorded due to a one slot shortened-pitch, i.e. due to a coil throw of 1 and 9 instead of 1 and 10. This basic layout of Figs. 1 and 1a shows both full-pitch and fractional-pitch conditions. Both methods show that top-sides are "keyed" to the full-pitch pole zone boundaries—the bottom coil-sides being the only variable for any chording or change in the coil throw. These diagrammatic methods show where, what, and by how much a phase is overlapped by another phase and the directions of currents are shown in every slot. In Fig. 1 it is seen that at the intersection of chorded pole zone boundary line with the full-pitch pole zone boundary line, the vector length gives the chord (pitch) factor for that particular coil throw. For instance: a coil throw of 1 and 9 or 180 deg — 20 deg = 160 deg span gives a chord factor of 0.985, and a coil throw of 1 and 7 or 180 deg — 60

[1]Presented in the April and June issues, respectively.

Table I Extracted Data from Fig. 1

				Magnetic pole zone 1						
				Phase Zones						
		A			B			C		A
				Slots and coils in magnetic pole zone						
	1	2	3	4	5	6	7	8	9	10
				Angle and phase for full-pitch condition						
(T)	A	A	A	B	B	B	C	C	C	A
	0°	20°	40°	60°	80°	100°	120°	140°	160°	180°
(B)	A	A	A	B	B	B	C	C	C	A
	180°	200°	220°	240°	260°	280°	300°	320°	340°	360°
				Angle and phase for pitch of 1 and 9						
(T)	A	A	A	B	B	B	C	C	C	A
	0°	20°	40°	60°	80°	100°	120°	140°	160°	180°
(B)	A	A	B	B	B	C	C	C	A	A
	160°	180°	200°	220°	240°	260°	280°	300°	320°	340°
				Angle and phase for pitch of 1 and 8						
(T)	A	A	A	B	B	B	C	C	C	A
	0°	20°	40°	60°	80°	100°	120°	140°	160°	180°
(B)	A	B	B	B	C	C	C	A	A	A
	140°	160°	180°	200°	220°	240°	260°	280°	300°	320°
				Angle and phase for pitch of 1 and 7						
(T)	A	A	A	B	B	B	C	C	C	A
	0°	20°	40°	60°	80°	100°	120°	140°	160°	180°
(B)	B	B	B	C	C	C	A	A	A	B
	120°	140°	160°	180°	200°	220°	240°	260°	280°	300°

All these values and more information per pole are visualized in Figs. 1 and 1a.

deg = 120 deg span gives a chord factor of 0.866. Thus, for a voltage E with full-pitch, the voltage for a coil throw of 1 and 7 would be .866E due to chording. These diagrams show that the chord factor depends upon the pitch of the coils, that the coil pitch depends on the slot pitch, and the slot pitch depends on their number and the number of magnetic poles but is independent of the number of phases. Per magnetic pole, the chord factor is indicated at the intersection of respective chorded pole-zone-boundary with the full-pitch slot (180 deg) position.

For the 36-slot and coil, fractional-pitch (1 and 9 coil throw) 3-phase 4-pole fully developed lap winding, the coil-to-coil and group-to-group connection procedure is exactly the same as that shown in Fig. 4 of Part II except that these have fractional-pitch coils and there are more coils per phase group in this winding. However, the number of coils in series per phase group and the number of pole pairs, whether more or less, does not alter the coil-to-coil and group-to-group connection procedure. Table I shows the extracted basic layout from Fig. 1.

It is evident that a decrease below 2/3rds or 120 deg pitch accelerates the decrease in reaction by the 120 deg components, and the N-S magnetic poles will become completely overlapped and neutralized at ½ or 90 deg pitch. It is also evident that with decrease in coil throw the magnetizing current decreases due to the machine attempting to maintain the rotating magnetic field at constant value, hence more current has to flow in the winding to produce the same magnetic field strength. The disadvantage is that a chorded coil does not enclose all the flux from a pole, so that the number of turns must be increased or a greater flux density produced if the same full-pitch voltage is desired. The coils may be given any pitch in whole slot numbers up to or down to 50 per cent of full-pitch. A close examination of Figs. 1 and 2 reveals:

(1)..The number of magnetic poles, phases, slots and coils, etc. in the winding, and the electrical angular degree positions and values of every top and bottom coil side.

(2)..The number of slots spanned per coil for full-pitch and fractional-pitch.

(3)..The two coil-sides of a chorded coil are out-of-phase with each other though they are connected in series.

(4)..The amount per slot by which the counter emf is reduced by chording.

(5)..Why two different directional phase currents flowing through each slot do not neutralize each other; that their phase relations are widely displaced and the currents have different magnitudes — one increasing while the other is decreasing.

The chord factor may be computed from formula k = sine (90 pitch). Thus—checking the 0.866 value shown in Fig. 1 for a 2/3rds pitch—the computed chord factor is sine (90 deg × 2/3) = 60 deg = .866. This factor is of relatively little importance in a winding connection diagram since the chief requirements are to visualize every coil side position, its angle, phase, etc.

For chorded windings in particular a picture showing the layout of phase zones and magnetic pole zones as also the angular degree values of every slot are important in view of phase current overlap. Comparing the basket, mesh and concentric type windings (see Part II) which show invaded phase zones, the lap type windings of Figs. 1 and 2 are seen to have much better coil distribution and symmetry among poles and phases.

Using Fig. 2, which shows a 36-slot and coil (3-slots and coils per pole-phase group) fractional-pitch of 1 and 8 (140 deg chording) 3-phase 4-pole lap winding, we can easily extract (1)..a fully developed *full-pitch* winding and (2).. a fully developed *fractional-pitch* winding from the same diagram. The fractional-pitch winding table reads as shown in Table II.

To extract a fully developed full-pitch winding from Fig. 2 merely assume that the bottom coil-

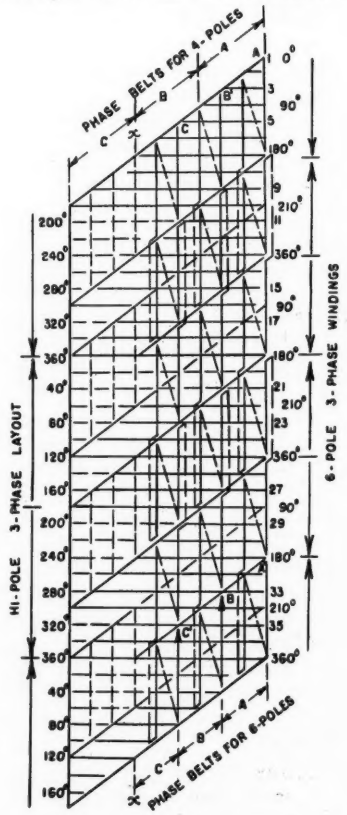


Fig. 3. Diagram showing reconnection of Fig. 2 to give a 36-slot and coil, 1 and 7 pitch (full pitch) 3-phase, 6 pole, fully developed lap winding. The diagram is drawn to show both the 4-pole and 6-pole basic layouts. Only that part of the diagram to the right of "36" need be shown

Table II Fractional Pitch Data from Fig. 2

A	(T)	(B)	(T)	(B)	(T)	(B)	(B)	(T)	(B)	(T)	(B)	(T)	
	1	8	2	9	3	10	19	12	18	11	17	10	
	A	C	A	C	A	A	A	A	C	A	C	A	
A′	28	35	29	36	30	1	28	21	27	20	26	19	We may assume this to be the *rotor* winding
	A	C	A	C	A	A	A	A	C	A	C	A	
B	31	2	32	3	33	4	31	24	30	23	29	22	
	A	A	B	A	B	B	B	B	A	B	A	B	
B′	4	11	5	12	6	13	22	15	21	14	20	13	
	B	A	B	A	B	B	B	B	A	B	A	B	
C	7	14	8	15	9	16	25	18	24	17	23	16	
	C	B	C	B	C	C	C	C	B	C	B	C	
C′	34	5	35	6	36	7	34	27	33	26	32	25	
	C	B	C	B	C	C	C	C	B	C	B	C	

Table III Full Pitch Data from Fig. 2

A	(T)	(B)	(T)	(B)	(T)	(B)	(B)	(T)	(B)	(T)	(B)	(T)	
	1	10	2	11	3	12	21	12	20	11	19	10	
	A	A	A	A	A	A	A	A	A	A	A	A	
A′	28	1	29	2	30	3	30	21	29	20	28	19	We may assume this to be the *stator* winding
	B	B	B	B	B	B	B	B	B	B	B	B	
B	31	4	32	5	33	6	33	24	32	23	31	22	
	B	B	B	B	B	B	B	B	B	B	B	B	
B′	4	13	5	14	6	15	24	15	23	14	22	13	
	C	C	C	C	C	C	C	C	C	C	C	C	
C	7	16	8	17	9	18	27	18	26	17	25	16	
	C	C	C	C	C	C	C	C	C	C	C	C	
C′	34	7	35	8	36	9	36	27	35	26	24	25	

sides extend two more slots, or to full-pitch position; that is to say, read from slot 1 to slot 10 and so on. The fully developed winding table is shown in Table III.

Fig. 2a is given in skeleton or base form in order to more clearly visualize the 4-pole layout and the electrically identical pole-to-pole (bottom to bottom) coil-side positions which are seen to be on the same circle per phase winding and at the auxiliary p o l e - z o n e - (chorded)-boundary-lines or positions; check with Fig. 2. It also shows the superimposed layout of a *stator* full-pitch and *rotor* fractional-pitch, or vice versa, in one base diagram; thus, two distinct winding layouts are visualized in the one diagram. The color portions show the reduced field area due to chording the winding.

Using Fig. 2 basic diagram so as to illustrate every operation, let us reconnect the 4-pole into a 6-pole winding without changing the coil throw. Fig. 3 now serves as the base diagram for both conditions. It shows that the resulting fully developed 3-phase 6-pole lap winding has full-pitch coils throughout. For the 4-pole machine we had $36/3 \times 4 = 3$-coils per pole per phase, but the 6-pole machine gives us only $36/3 \times 6 = 2$-coils per pole and phase: hence the phase belts of the latter are narrower than those of the former winding.

QUESTIONS

(1)..What is the pitch in terms of slots spanned, and how many slots would be spanned in a 4-pole 3-phase 12-slot and coil fractional-pitch (120 deg chorded) lap winding?

Ans. Coil pitch is 1 and 3 and the number of slot spanned is 2, or 0 deg to 60 deg and 60 deg to 120 deg.

(2)..For a coil throw equal to 50 per cent full pitch, or 90 deg, what would be the pole-arc equivalent for a full-pitch reconnection.

Ans. A 8-pole full-pitching winding

(3)*..Whether full-pitch or chorded, the two coil-sides of a coil are in series, and for the former condition the top coil-sides are always in phase but certain coil-sides for the latter condition are out of phase: (a)..What effect has the latter on the magnetic field? (b).. If full-pitch normal supply voltage be applied to the latter winding would it be subjected to under or over voltage—if so why, if not why not?

(4)*..Which winding has the greater advantage from chording, that with the greater number of slots and coils or that with relatively few slots and coils and the same number of pole pairs?

(5)..For a coil throw of 1 and 9 shown in Fig. 1, what is the chording and the chord factor?

Ans. The electrical angular degree of the coil throw is 160 and the chord factor of this angle is .986.

(6)..Let us double the number of slots and coils shown in Fig. 3 and assume that it now represents a 72-slot and coil 3-phase 4-pole lap-connectd 400-v star-connected induction-motor stator winding. Further assume that the computed number of turns per phase works out at 108, or $108/(36/3) = 4.5$ turns per coil. For these conditions determine the voltage developed per turn, volts per phase, the best coil-throw and resultant chord factor, and the required supply voltage.

Ans. The initial voltage per phase is $400/\sqrt{3} = 230$, and, as each turn develops $230/108 = 2.1296$ v, the equivalent chord factor required to reduce this voltage to 230 is $(230 \times 1.0)/(256 \times k) = .899$, which is not practical because there is no slot in that angular position. The electrical angular degree between adjacent slots is 180 deg/(72/4) = 10 deg hence the coil pitch for a full-pitch winding would be 180 deg/10 = 18 slots spacings or span of 1 and 19. We have a choice of slot 18 or 17 or 15 and so on; but the question is to get that product of kE nearest to 230 volts. A chording of 1 and 14 best meets this condition; that is, 180 deg − 50 deg = 130 deg, the chord factor for which is sin. 90/(13/18) = sin. 64.98 deg = 0.906. Therefore the required supply voltage is $256 \times 0.906 = 234.6$ volts per phase, and $234.6 \times \sqrt{3} = 405$ v between phases.

(7)..Carefully examine Fig. 1 for condition of 1 and 7 coil throw, then state what coil sides are not overlapped by another phase current.

Ans. Examination shows that every coil side is overlapped by another phase, i.e. each coil side in phase A is overlapped by phase B, coil side on phase B is overlapped by phase C and phase C is overlapped by phase A.

(8)..Using Fig. 2, state what coil side and which phase current overlaps the top coil side in slot 21 of phase A.

Ans. Follow slot 21 to the left and note that bottom coil side of coil 15 to 21 and phase B overlaps the top coil side in slot 21 of phase A; see also Fig. 2.

*The reader must answer these questions.

Lead Alloys to Replace Tin for Engine Bearings

In meeting the tin shortage and the threat that material has made in a highly important application, engineers of the Cooper-Bessemer Corp., Mt. Vernon, Ohio, believe they have found ways to produce alloys of lead to take the place of tin alloys in bearings.

The new lead alloys are being subjected to gruelling trials for bearing use.

Alloys with lead as the base metal have been put into bearings of the corporation's Diesel engines and air compressors, and from all indications are said to be doing well.

A year of testing will be required to prove beyond doubt that lead is an adequate substitute. Tests have been run in the Cooper-Bessemer plant for the past several weeks, and there are possibilities that lead may produce better bearings than ever before. The fact alone that tin is being allotted by the War Production Board makes it a strategic material, and with imports from the Far East cut off the necessity for a substitute metal becomes an essential problem for research.

This has caused industry to turn very rapidly to bearings with lead as the base metal. The composition of the lead base alloys is being kept a carefully guarded secret. It varies somewhat with different industries. They must duplicate as nearly as possible the desirable qualities of tin as a base metal.

The most critical test that could be put to a new bearing alloy is its use in an internal combustion engine such as a heavy duty Diesel.

Store Coal Now To Meet Coming Production Peak

With the peak of war production still to come, our now fully-equipped industries must continue in the summer of 1943 the same sort of coal storage program that aided them in meeting all 1942 war demands. Demands on our transportation system and our mines will be even greater this year. The threat of a coal stoppage by miners' strikes is intensified. More iron ore must be shipped by water, increasing the coal-hauling load by rail. Large movements of crops, troops, and military supplies will be necessary. Manpower and equipment in mines must be utilized most efficiently, eliminating the slack season, and averaging 2,000,000 tons a day to meet an expected demand for 600,000,000 tons of bituminous coal, an increase of 20,000,000 tons over 1942. In short, coal users should order and store all the coal they can get when they can get it, to protect themselves against interruptions in production. This article reviews the coal storage situation in 1943 as compared with that in 1942, summarizes the best accepted methods of storing coal, fully treated last year, gives sources of further data.

By Chester R. Earle, ***Associate Editor***

IN VIEW of the occurrences of the past year and particularly those of the past few weeks, when a stoppage of coal production actually occurred and a more serious one threatened, power engineers need little urging to give close attention to their fuel supply. This is always a major consideration in normal times to prevent production interruptions for economic reasons. In wartime, such stoppages are a military, not an economic, matter. These factors have always been clearly understood by engineers.

Reasons for careful attention to coal storage by power plant engineers under present conditions were discussed in detail in the Coal Storage Manual section of POWER PLANT ENGINEERING, July, 1942 issue. That manual also discussed fully the best accepted practice in storing coal.

Why Store Coal Now?

The present campaign being conducted by the Solid Fuels Administration for War (SFAW) is based on the same general factors that obtained last year, amplified in some respects by the experience of the past year. The power industry as a whole, working under tremendous handicaps, has done an outstanding job[1] of meeting all the nation's demands for the electricity required to drive our war industries. Those industrial plants are practically all tooled up; now they must run at maximum capacity to produce the war weapons. Consequently coal users must store coal now for three main reasons:

1. To insure a continuous supply of electric power and process steam for war production in spite of threatened or possible transportation difficulties, strikes, sabotage or air raids. The first, transportation difficulties, is the most serious hazard but the recent coal strikes and the assumption of mine control by the U.S. Government demonstrates that strikes also can be a serious potential threat to the industrial coal supply.

2. To make optimum use of manpower and mine facilities by more uniform production through the year and minimize the usual seasonal slump in coal production.

3. To relieve the transportation facilities of unnecessary duty during fall and winter months when crops must be moved, large troop movements are necessary and war production is at its peak.

But there is more. During the coming winter, coal users may not be able to get the coal best suited to their needs, may have to take what they can get. Coal operators under pressure, cannot always provide full tonnage of the coals desired. Mines of inferior grade coals, often strip mines, have had to be worked. Even so, there may still not be enough coal to go around and coal rationing for next winter is being hinted at.

[1] POWER PLANT ENGINEERING, Feb. 1943, page 82, Power Plant Industry Meets War Demands in 1942; May 1943, page 57, Electric Power Supply, by C. W. Kellogg; April 1943, page 59, Keep Them Running.

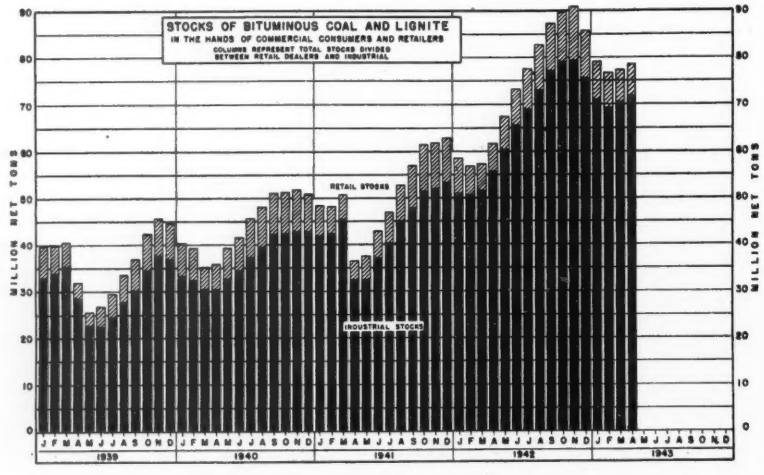

STOCKS OF BITUMINOUS COAL AND LIGNITE
IN THE HANDS OF COMMERCIAL CONSUMERS AND RETAILERS
COLUMNS REPRESENT TOTAL STOCKS DIVIDED BETWEEN RETAIL DEALERS AND INDUSTRIAL
RETAIL STOCKS
INDUSTRIAL STOCKS
MILLION NET TONS
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1939
1940
1941
1942
1943

Fig. 1. Diagram showing stocks of bituminous coal and lignite, as reported to the Bituminous Coal Division, Department of the Interior

Fig. 2. A 15-ton tractor and bulldozer piles coal at the plant of a large industrial company

With steam-using equipment wearing out faster and replacements difficult, it may be harder to burn coal at best efficiency or to use poorer coal. Power plant labor, too, has been drawn off into the armed forces, leaving fewer good operators. Fuel conservation measures, considering the relations between fuel oil and coal, may have to be taken. Conversion of many plants from oil to coal[2] may still further increase the demand for coal.

The bulk of the increased wartime coal requirements are coming from the enlarged fuel needs of war industries, the need for more steam-electric power generation and greater use in steam locomotive operation, says Howard A. Gray, Deputy Solid Fuels Administrator for War. In addition are the increased demands for coal by former users of other fuels now insufficient for their needs.

The SFAW has estimated that approximately 600,000,000 tons of bituminous coal and 65,000,000 tons of anthracite must be produced in 1943 to meet the nation's coal needs. To provide this 600,000,000 tons of bituminous coal in 1943, an increase of 20,000,000 tons above the estimated production of our mines in 1942, the mines must maintain a production averaging about 12,000,000 tons a week or 2,000,000 tons each working day.

[2]POWER PLANT ENGINEERING, June 1943, page 76, July 1943, page 66. Conversion From Oil Firing to Coal Firing, by Ollison Craig.

Coal in Storage, Consumed and Day's Supply

Stocks of bituminous coal and lignite held by industrial consumers and retail dealers in the United States at the end of April, 1943, are shown in Fig. 1. The greatest amount in storage. in November 1942, was 91,000,000 tons. At the end of April 1943, according to the June 1 report of the Department of the Interior, there was 78,666,000 tons in storage, as compared with April, 1942, when slightly over 60,000,000 tons was on hand. The curve of stocks on hand is now rising slowly again and during the summer it is expected that coal stocks on hand will increase in the same manner as last year. The accompanying table shows the industrial distribution of coal in storage at the end of the month of April, 1943.

One important point made by the SFAW is that coal users wherever possible will do well to avoid insisting on particular coals and instead attempt to adapt their operations to coals that can be provided more easily, even though not the most desirable from the engineering point of view.

Design of some plants already permits considerable latitude in this respect; in others it is difficult or impossible without equipment changes that cannot now be made. In short, coal users may have to sacrifice some things for the sake of continuity of war production.

Consumers who fail to stock coal this summer will get all possible help from the SFAW to prevent curtailment of war activities but cannot expect to get just the

Table showing stocks and consumption of bituminous coal and lignite in U.S., April 1943. All data in net tons

Industry	Stocks End of April '43	Consumption During April '43	Day's Supply End of April '43
Electric Power Utilities	19,703,000	5,497,000	108
By-product coke ovens	9,730,000	7,496,000	39
Beehive coke ovens	.....	1,079,000	..
Steel & Rolling mills	1,161,000	977,000	37
Coal-gas retorts	374,000	139,000	81
Cement mills	782,000	466,000	50
Other industrials	27,000,000	12,200,000	66
Railroads (Cl. 1)	13,175,000	10,764,000	37
Total Industrial stocks	71,925,000	38,580,000	56
Retail Dealer stocks	6,740,000	9,580,000	21
Grand Total	78,665,000	48,160,000	49

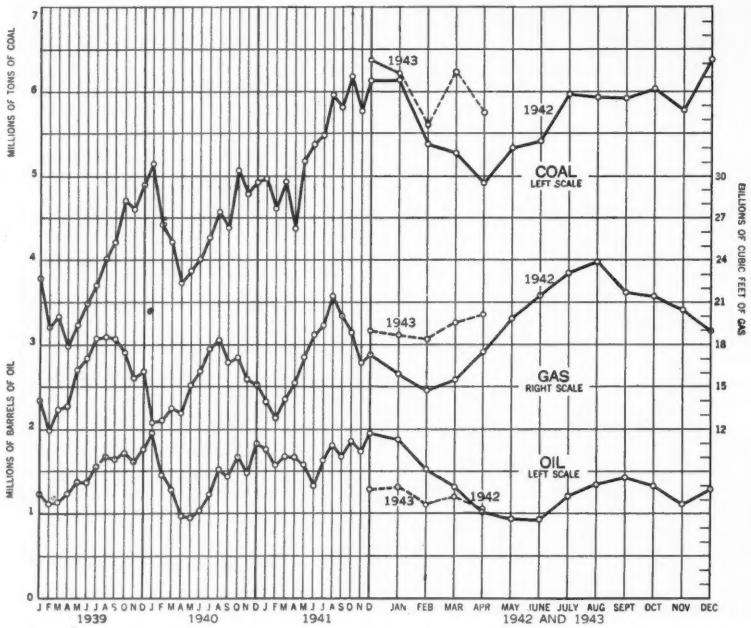

MILLIONS OF TONS OF COAL
MILLIONS OF BARRELS OF OIL
BILLIONS OF CUBIC FEET OF GAS
1943
1942
COAL
LEFT SCALE
1942
1943
GAS
RIGHT SCALE
OIL
LEFT SCALE
1943
1942
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1939
1940
1941
JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV DEC
1942 AND 1943

Fig. 3. Consumption of Fuel for Production of Electrical Energy in the U.S., 1939-1943

coal wanted if they have failed to obtain it when it was available. Nor will the cost to the consumer of obtaining coal by emergency arrangements be of great concern to the Government.

In short, the coal consuming power industry has shown by its results during the past year that proper cooperation in the coal storing program is the best way to insure industrial production even though the same problems will continue and intensify. The success of the program last year is a good demonstration of its fundamental soundness as a war measure.

Methods of Storing Coal

Best modern methods of storing coal were so completely covered in the POWER PLANT ENGINEERING Coal Storage Manual, published in July, 1942, that they need little further discussion. The widespread adoption of the layer method of piling has been most successful. In fact, engineers have been impressed with the way in which the widespread adoption of these modern methods has decreased losses of stored coal by weathering, spontaneous combustion and other forms of degradation.

The whole subject of coal storage and storage practices was thoroughly treated in a panel discussion by leading engineers at the ASME Spring Meeting, Davenport, Iowa, April 26-28, 1943.[3]

[3]Reported in POWER PLANT ENGINEERING, June 1943 issue, page 88.

The points brought out by this panel reinforced and amplified the accepted practices in coal storage outlined in the Coal Storage Manual and may be summarized as follows:

Select storage area that requires least transportation of fuel, is well drained and not subject to flooding.

Prepare bed by removing all debris and scraping around to get rid of shrub and grass roots. A layer of crushed rock is sometimes recommended.

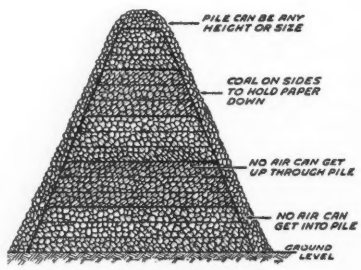

PILE CAN BE ANY HEIGHT OR SIZE
COAL ON SIDES TO HOLD PAPER DOWN
NO AIR CAN GET UP THROUGH PILE
NO AIR CAN GET INTO PILE
GROUND LEVEL

Fig. 4. Method of excluding air from coal storage piles by use of paper between layers in pile

Any kind or size of coal can be successfully stored if not segregated.

Spread coal in layers with bulldozer or similar equipment, to prevent segregation of sizes, and compact with caterpillar tractor, roller or truck wheels. Some recommend that each layer be rounded so as to drain. Compacted coal should occupy about 15 to 20 per cent less space than loose pile. Pile so that no air currents or chimneys can be created through coal. Flat top piles are preferred. Prevailing winds should blow across piles. A convenient size pile is 100 ft by 50 ft by 8 ft. All foreign materials should be kept out of pile; don't pile around posts.

Inspect pile frequently, particularly immediately after piling, and in spring and fall. Dig out and use or cool the coal from spots where temperature reaches 150 F. Reclaim from end of pile.

Another good summary of the subject is given in Information Circular 7235 entitled The Storage of Coal, by J. F. Barkley, Chief Division of Solid Fuels Utilization for War, Bureau of Mines, U.S. Department of the Interior, published in February 1943. (This is a revision of Circular 7211.)

Development of new types of hot spot indicators and methods for introducing CO_2 into coal piles[4] has occurred during the past year.

A recently patented method[5] for sealing coal storage piles to prevent oxidation involves the use of Sisalkraft paper, as shown in Fig. 4. Coal is piled in layers, leveled and compacted by roller or bulldozer, then the layer is covered on top and sides with the paper. Other layers of coal, compacted and covered with paper in the same way, are laid until the pile is completed. The paper on the sides and ends of the pile is covered thinly with coal. This method is now in use at a plant of Bethlehem Steel Co.

[4]POWER PLANT ENGINEERING, Jan. 1943, page 82.
[5]POWER PLANT ENGINEERING, April 1943, page 93.

Harbor Steam Plant Goes on the Line

IN THE one-line electrical diagram of the Harbor Steam Plant. Fig. 7, page 114, June issue, readers have doubtless noticed that the 4000-kw auxiliary generator is labeled 13,200 v, but should have been labeled 2300 v, since it is connected directly to the 2300-v auxiliary bus without a transformer and obviously must operate at 2300 v. This error occurred on the original drawing and escaped the attention of authors, editors, and eagle-eyed proofreaders, all of whom knew better. Our face is suffused with cerise.

Turbine Maintenance in Hawaii

Ocean transportation plus war conditions augment turbine operation difficulties in Hawaii over those on mainland making necessary extreme care in the treatment of feedwater to secure clean steam and prevent scale on blades, and the regular, thorough and frequent inspection of the turbine elements to detect needed repairs and prevent unscheduled outages of power equipment

By A. F. Wallace,

Factory Superintendent, Waialua Agricultural Co., Ltd., Waialua, Oahu, Hawaii

TURBINE maintenance as practiced in Hawaii is little different from standard practice on the mainland. The problem to those of us in Hawaii has always required a little more attention than it does on the mainland primarily because of the ocean transportation problem in obtaining spare parts.

Even before our rude awakening on December 7, we had had the same problems created by priorities added to our other problems in no less a degree than in the Continental United States. Our action and methods of coping with the new problems are probably the same as practiced elsewhere. This leaves the ocean transportation problem the principal difference in viewing turbine maintenance and this is of relatively small importance. From my experience, both on the mainland and here, I believe that this difference results in a slightly larger stock of spare parts being carried by turbine operators in Hawaii.

Influence of Feedwater Quality

A consideration of turbine maintenance may as well start with the quality of steam. Steam quality has a definite bearing on the life expectancy, repair and upkeep of the unit. Many turbine units previous to the incidence of the emergency were operating on dry and saturated steam and since the emergency, many more standby units have gone into operation under similar steam conditions. Dry and saturated steam at the throttle, where there are no superheaters in the boilers and where the steam is not reduced from a higher pressure to the turbine throttle pressure, may mean anything from possibly as low as 95 per cent quality to nearly 100 per cent quality depending on the boiler installation, rate of evaporation and the quality and treatment of the boiler feedwater. With steam that is not dry and saturated at the throttle, there is an impingement of water particles on the blades, cylinder walls, and to a lesser extent on the spindle from the first stage onward increasing as condensation increases through the turbine from the high to the low pressure end.

With properly treated boiler feedwater and adequate steam generating units, the problem with dry and saturated steam in the turbine is mainly one of erosion. With improperly treated boiler feedwater or forcing of boilers, the erosion problem may not be the major one. Carryover of foreign material with the steam from the boilers will be partially deposited on the turbine blades. This may reach serious proportions in a comparatively short time.

The use of superheated steam overcomes the erosion problem in the earlier stages of the turbine, but of course erosion is present once the dew point of the steam is reached. Quality of the boiler feedwater is still a factor, but ordinarily this is looked after much more carefully in superheated steam boiler installations than in those without superheaters. There are, however, installations of high pressure and high superheat where there is a carryover of foreign material with the steam that is deposited on certain rows of high pressure turbines. In the latter case the turbine manufacturer has devised methods of washing soluble deposits from the blades and should be consulted as to the method to use.

If the scale deposit is insoluble it may become necessary to dismantle the turbine for cleaning. In either case the time of cleaning may be easily determined by noting the increased pressures above normal, for any given loads at those stages of the turbine to which gages are attached and consulting the manufacturer for maximum allowable pressures, if this information is not available from past performance records. This should be done before any abnormal increase in pressures occurs, otherwise serious damage may occur to the blading before remedial measures are undertaken.

Steam Control Equipment

Steam first enters the turbine through the throttle valve. The function of the throttle valve is primarily to control the steam to the unit when starting up, and shutting off practically all of the steam to the turbine when it is closed by hand. It is not a stop valve and is not required to be absolutely steam tight. Its other important function is to close rapidly when tripped by the overspeed stop to protect the turbine from overspeeding. Therefore, it should operate freely at all times. Any sticking or undue friction in the operation of this valve should be investigated immediately. When shutting down and with the load off the turbine, this valve should be tripped and its action observed. The turbine rotor should come to a complete stop when this valve is in the closed position.

The overspeed stop prevents the turbine from overspeeding by tripping the throttle valve when the speed of the unit reaches approximately 110 per cent of normal. It is an important device that should receive as close attention and respect as boiler safety valves. It may never be called upon to operate except for test purposes, but this is even more reason why it should be

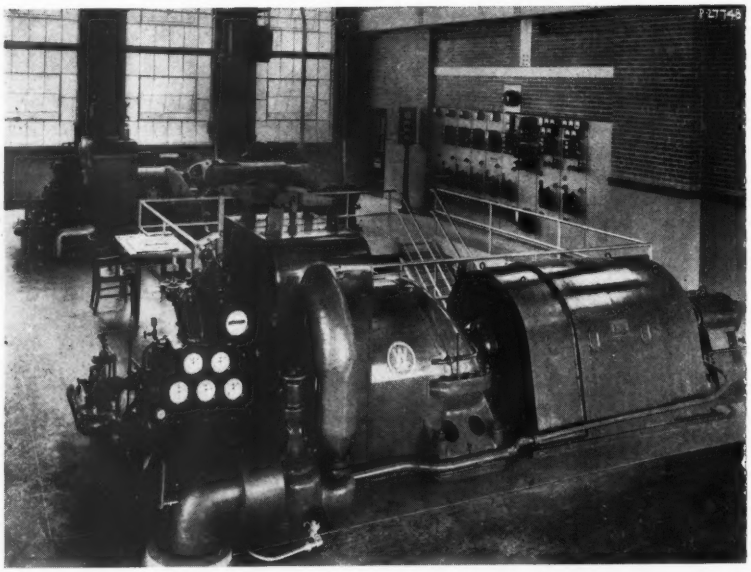


Fig. 1. Typical condensing steam turbines of 1500 kw capacity whose satisfactory service depends in large measure upon careful attention to operating details

tested periodically. Yearly cleaning and inspection is necessarily followed by testing at speed or by the manufacturer's recommended procedure for larger turbo-generators. Any grooving of the stop plunger by the spring calls for a replacement of the plunger, and probably the spring. The spring, by bearing in the grooves worn on the plunger may effectively resist the plunger from operating before serious damage has already occurred to the turbine. Proper attention and upkeep of the overspeed stop and the safety or throttle valve which it controls may prevent the occurrence of an embarrassing situation.

The governor, operating through the governor valve, is called upon to maintain uniform speed of the turbine within the designed limits. A governor will continue to give satisfactory service with little attention provided a minimum of friction and clearances is maintained in its moving parts. If a flyball governor, the condition of the knives and knife edges are also important. If a hydraulic governor, the relays, bleed-off openings and venting of the impeller should be investigated each repair period.

The governor valves may be directly controlled by the governor mechanically or hydraulically. In either case, freely operating valves without undue friction are necessary for proper speed regulation. Again, the clearances of the various operating mechanisms must be kept to a minimum. Otherwise speed and/or load fluctuations will result. Governor valves need be only reasonably tight. When the governor valves are closed and the turbine is at normal speed, the rpm should rapidly decelerate. Adjustment of the valves to operate in proper sequence and without lag or overlapping can be quickly checked by bringing each valve into operation and noting the throttle pressure and inlet pressure to the valve reaching full open position. Proper pressure drop between the throttle and full open governor valve and methods of adjusting the next valve in sequence to open without lag or overlap will vary according to turbines.

Lubrication Precautions

For lubrication, a good turbine oil of the recommended viscosity is required. The maintenance of a clean oiling system at all times is equally as important. The oil must be kept free of dirt, grit, water, and other foreign substances to maintain proper protection. After all, the turbine journals float on an oil film about one mil in thickness and even a momentary destruction or failure of this film may cause sufficient damage to the bearings that lubrication cannot be adequately reestablished.

The oil serves yet another and possibly two other purposes besides that of lubrication. The heat caused by friction must be dissipated in some manner and most of this heat is carried off by the excess quantity of oil supplied to the bearing for that purpose. If the oil is also used as a hydraulic medium, an oil satisfactory for lubrication is also satisfactory for use in hydraulic mechanisms—except in dual systems when a high flash point liquid is required in one.

The oil strainer accumulates a small amount of foreign material during operating periods. This is particularly true following repairs or an overhaul. It follows that the strainer should be inspected and cleaned more often following repair work. Since the oil strainer is a catch-all for everything returning from the bearings, any distress in a bearing from wiping is returned as evidence to the strainer. For this reason, frequent inspection of the strainer is justified even though turbine bearings rarely give trouble.

Oil coolers should be inspected and tested periodically. To prevent water entering the system here, it is preferable to have the oil passing through the cooler at a slightly higher pressure than the cooling water. Some protection should be given the turbine should a sudden loss of oil reduce the reservoir supply below minimum requirements if such protection is not already incorporated in the turbine design.

Faulty Conditions Demand Inspection

Damage to the blading will give the same outward results as will dirt accumulating on the blades. If there is a sudden or rapid increase in turbine zone pressures for any given load, the cause is almost certain to be blade damage except in extraction turbines where the cause may be in the extraction valve or faulty operation of this valve.

Frequency of turbine inspections will vary according to operating conditions, age, and availability. Ordinarily a yearly inspection is often enough, but at any time that conditions within the turbine become abnormal an inspection should be made at once.

Internal turbine inspection should include a close inspection of all blading, lashing wires, shroud strips, blade grooves and blade anchorages. Erosion of spindle body and cylinder walls should be measured and recorded. If the erosion is excessive, increased steam consumption caused by leakage past blade tips will have increased operating costs to

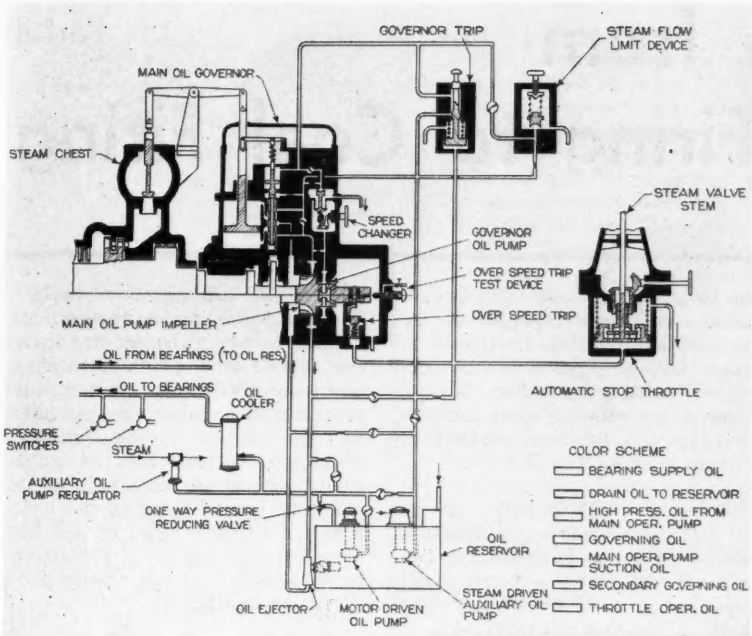


Fig. 2. Diagram of the auto-stop governor of a large industrial turbine tied in with the throttle valve and governor control system

a point where an investigation of operating economies to be gained by making major repairs is not only warranted but dictated. The erosion may have gone so far that blade anchorages may no longer be adequate.

Journals and bearings should remain in much the same condition as when first installed provided lubrication has always been satisfactory, alinement has been maintained and allowable vibration limits have not been exceeded. In starting up a unit, the journals will make a quarter revolution before an oil film is established. If starting is frequent enough this may cause appreciable wear over a period of time.

Turbine vibration can be corrected rather inexpensively and good operating practice should include maintaining turbines in

Fig. 3. Erosion of turbine blading caused by moisture in the steam

smooth operating condition. First, the location of the vibration must be determined, whether in the turbine, coupling, connected load or harmonics in the supporting structure. The method of balancing, whether in its own bearings or in a suitable balancing machine is a matter of economics. A turbine rotor in poor balance not only sets up additional stresses in the turbine rotor and its supporting structure but also causes the same reaction among operating personnel as poor housekeeping. Because the turbine is not purring along as it should, they either intentionally or not tend to be less exacting in their work.

Maintenance of turbines is no different from maintenance of other machinery. Given the proper supervision, and working conditions, plant operators and maintenance men will keep up their equipment. If during yearly overhauls, however, parts that should and can be renewed are not renewed with consequent later outages and extra work required on the part of the maintenance crew and operators, the morale of the men will become somewhat indifferent and work will suffer. In other words, the attitude of the supervisory staff will be carried through by the men doing the work. If oversight or neglect is tolerated by those responsible, then it follows that the same can be expected all along the line.

Qualified Repair Men

Usually the best qualified man to inspect a turbine and supervise the repairs is the manufacturer's service representative. He is not a cure-all, but his experience and training, plus his contacts with his own engineering department, makes his services valuable to those operating turbines. Any peculiarities or abnormal operating conditions should be discussed with this representative during the course of the overhaul so that he can better take care of necessary corrections as work progresses. A report of a turbine's condition from a competent outside observer is valuable to the operating personnel and management.

The various factors of turbine maintenance are so interlocked that one cannot say that any one factor can be overlooked without trouble resulting. For the most part changes in operating characteristics will be manifest in the controls or stage pressures of the turbine. Except in the cases of accidents, the changes are usually gradual and may be watched over a period of time. The time chosen for making the necessary adjustments or repairs can then be made when most convenient provided the conclusions drawn from the observations are correct.

TO CUT OFF POWER in war plants in case of a short circuit caused by lightning, bombs or sabotage, Westinghouse Electric & Mfg. Co. engineers have devised electrical control equipment. A metal tube containing fiber rings and a thin copper strip carries the power supply current. A short circuit melts the strip, and the resultant electric arc is choked by gases from the heated fiber.

DON'T TALK SHOP. The only person who cares to hear about your job is the enemy. If you happen to be turning out shell casings and the man next door is a turret welder why not talk about the Chicago Bears or the Green Bay Packers the next time you meet him down at Joe's? Hitler doesn't care who will cop the football championship this fall; he's playing in another league. The kind of scouts that work for Adolf don't care about Notre Dame's yardage gained by scrimmage; they want to know how many shell casings you turned out last week and how many you'll turn out next week.

Conversion from Oil Firing to Coal Firing

Part II

IN DESIGNING a furnace for pulverized-coal firing, the type of furnace should first be decided. Amount of water cooling to be applied to the furnace walls can be determined from curves such as those in Fig. 3.* In determining the amount of water-cooled surface, if any, the high rates of release per square foot occur only at peak loads. If these are short, it would be better to reduce gas temperatures by means of excess air rather than to spend money for water tubes on furnace walls. In any case, full advantage should be taken of the boiler tubes themselves. Furnace should be arranged so that the first bank of tubes will be exposed for as much of its length as possible. Having determined the type of furnace, its size can be determined from curves such as Fig. 2.*

*Figures 1 to 5 inclusive illustrated Part I, Pages 76-79, June, 1943 issue. They should be referred to in reading Part II.

Furnace Bottoms

All of the above discussion in connection with furnaces for pulverized-coal firing is predicated upon removal of ash in dry form and not on slag tap removal.

Furnace bottoms may be flat, as in Fig. 4,* or sloping. Expense of ash removal by hand is greater than if a hopper bottom is used from which ash can flow directly into ash-conveying equipment. If hopper bottom furnaces are used, the overall setting will be higher, requiring not only greater cost in resetting the boiler, but greater cost for the enveloping building. If hopper bottoms are not water cooled, the slopes should be quite steep, at least 70 deg to the horizontal, for pulverized-fuel ash has a tendency to adhere to refractory surfaces and does not readily flow down an incline.

Comparison of Three Conversion Methods for a Typical Boiler

In making selections between various forms of coal firing, it is

Fig. 6. Design for converting a typical oil-fired boiler to firing by multiple-retort underfeed stoker

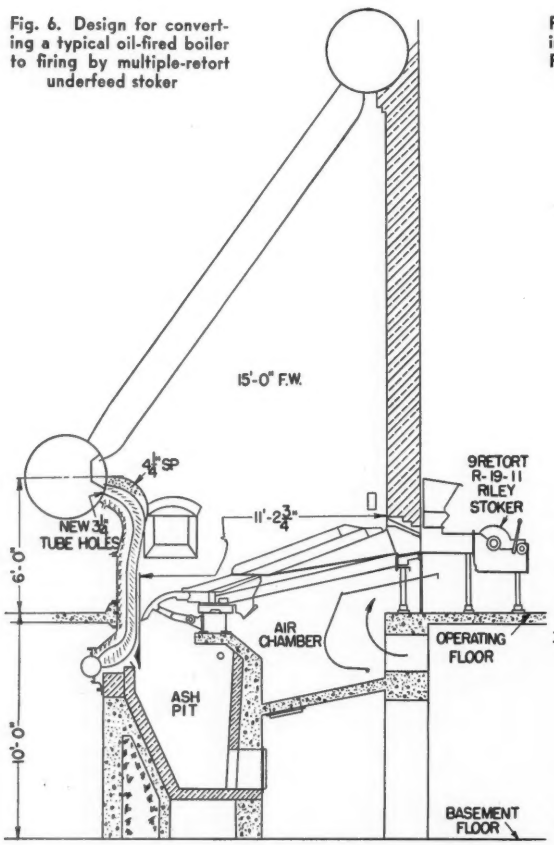
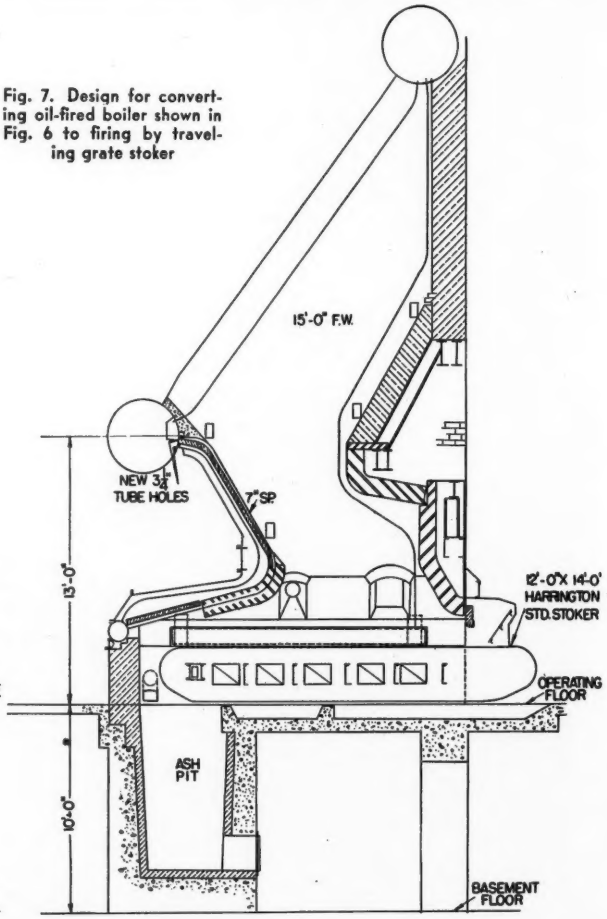


Fig. 7. Design for converting oil-fired boiler shown in Fig. 6 to firing by traveling grate stoker



By Ollison Craig

Engineering Manager
Riley Stoker Corp.

This is the continuation and conclusion of the article of which Part I was published on pages 76-79 of the June, 1943 issue. When considering conversion of a given boiler or boilers from oil to coal firing, it is often necessary or desirable to analyze several coal firing methods to determine not only the capacity obtainable but also the way the different types of equipment will fit into the plant. These analyses, of course, are the basis for cost comparisons between various ways of doing the job. The author gives details of three designs for an oil-fired boiler conversion, comparing the conditions for firing with underfeed stoker, traveling grate stoker and pulverized coal. Details are also given of the furnace and boiler changes necessary for converting a battery of two boilers with a parti-wall between them, so as to secure the required capacity. In enlarging furnaces, attention must be paid to furnace bottoms and walls. These must be designed to provide the required boiler capacity and furnace volume and at the same time provide for ash removal, since in most conversions the ash will be removed dry. If all-refractory furnaces cannot be enlarged sufficiently, water walls can be applied but excessive amounts of water-cooled surface should, in general, be avoided. In any event, it will be well to make conversions on the basis of good engineering advice and judgment rather than to make a maximum saving on the initial installation at the risk of future trouble.

useful to visualize the way equipment will fit into a plant. A study was made of a proposed boiler installation in which existing boilers were being fired by oil in one location and it was desired to move them to another location and fire them with coal. Three designs were studied: Fig. 6, with a multiple-retort underfeed stoker; Fig. 7, with a traveling grate stoker; Fig. 8, with pulverized-coal firing.

There is considerable difference in boiler elevation above the lowest level of the plant, hence the pulverized-coal installation should be installed for less initial cost, both for the boiler units and for the building. If it had been necessary to provide for water-cooled hopper bottoms in Fig. 8, the pulverized-coal unit would be as high as the others and the total cost would probably become greater.

Conversion Under Adverse Conditions

Two illustrations indicate things that might be done under adverse conditions. Figure 9 shows two straight-tube 600-hp boilers set in battery in a utility plant. Previously this battery contained a parti-wall dividing the two furnaces under the two boilers, which were fired with oil. With no change in the existing furnaces, their size would have limited the capacities obtainable from these boilers to an amount not permissible.

The furnaces were rebuilt and the parti-wall removed. A suspended wall was hung, as shown

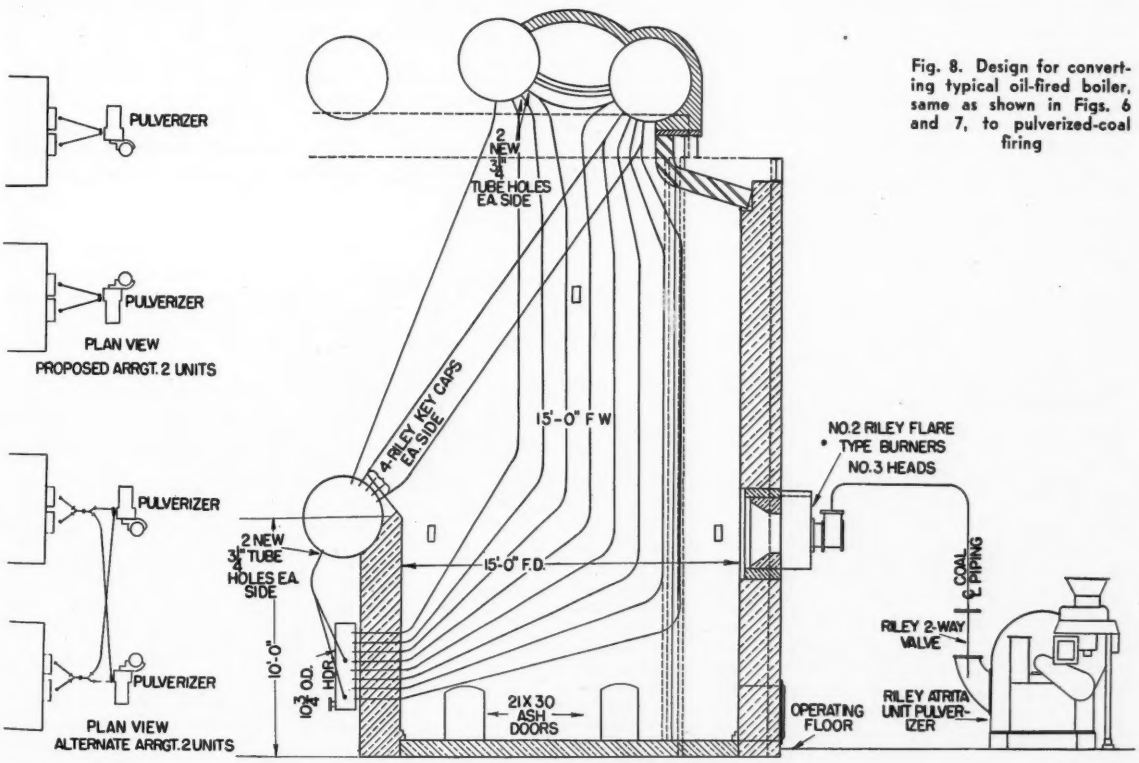


Fig. 8. Design for converting typical oil-fired boiler, same as shown in Figs. 6 and 7, to pulverized-coal firing

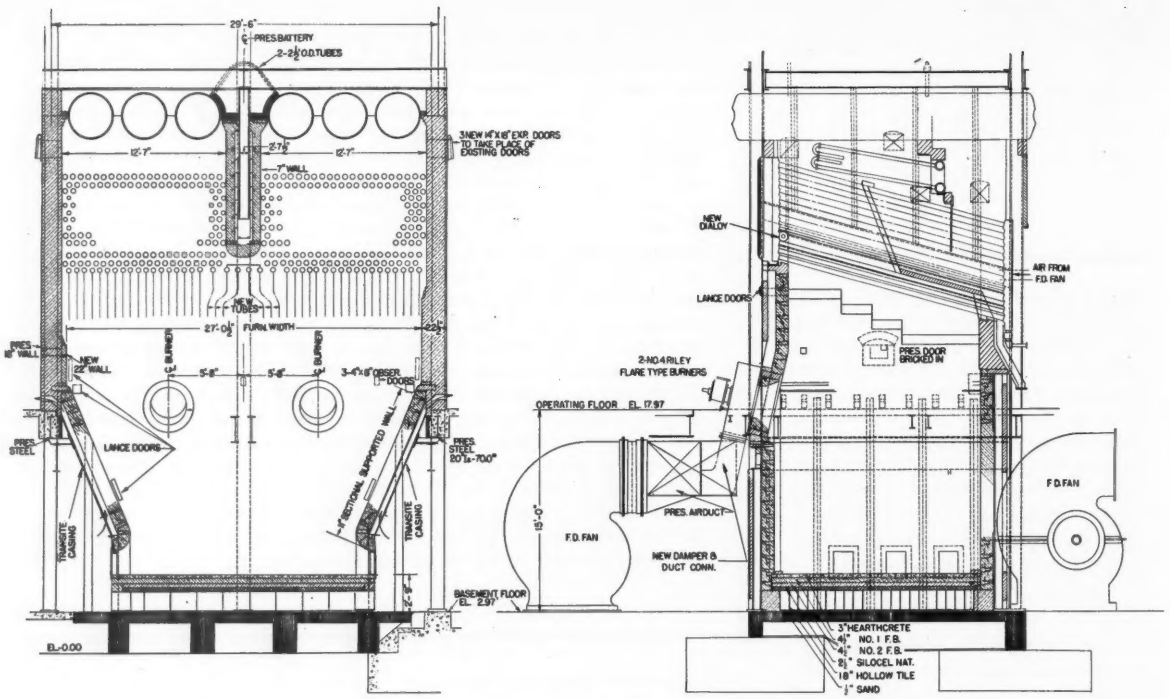


Fig. 9. Two 600-hp boilers in battery were converted to pulverized-coal firing by removing a parti-wall and deepening furnaces, with furnace side walls sloped to provide ash handling space

in Fig. 9, between the tube banks of the two boilers and extended to a point about even with the third row of tubes. Four tubes were then bent out in such a way as to partially shield the underside of this suspended wall. The volume contained in the original parti-wall then became furnace space. The furnace bottom was dropped to a lower level.

Adjacent to this dual unit is a duplicate unit. The space between the two units is so small that if the furnace width at the bottom had been the same as the furnace width at the top, ash could not have been raked off the furnace floor. By sloping the furnace sides, as shown, a greater distance between the units at the floor level was obtained and the width of the floor from which ash must be removed was reduced.

Figure 10 shows one of a number of 600-hp straight-tube boilers in a large office building. These boilers were originally fired with oil and the furnace bottom was level with the operating floor. Here again the furnace was adequate for oil firing but not for pulverized-coal firing. However, the furnace could not be dropped straight down because of existing equipment that could not be moved. Sufficient volume was obtained by locating the furnace bottom at the basement floor level and having a long slope on the rear wall. While this is not the most desirable design, it did provide a furnace of the capacity required, without experiencing trouble.

Frequently it is possible to enlarge furnaces of this type by extending walls down vertically in the manner shown in Fig. 1. With large boilers, large floor areas are obtained from which ashes must be raked. If an all-refractory furnace cannot be enlarged enough to obtain desired capacity, then water walls can be applied, permitting a higher rate of heat release and securing desired capacity with the volume which can be obtained. Water walls can be applied in many ways. In general, on a change-over, excessive amounts of water cooling should be avoided.

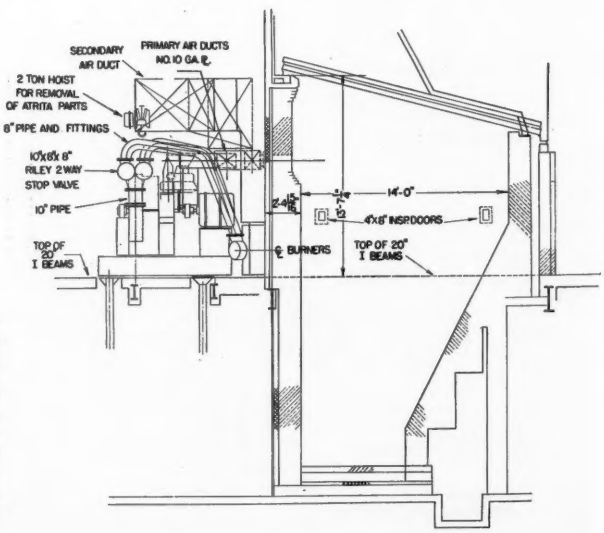

SECONDARY AIR DUCT
PRIMARY AIR DUCTS NO. 10 GA. R.
2 TON HOIST FOR REMOVAL OF ATRITA PARTS
8" PIPE AND FITTINGS
10"x8"x 8" RILEY 2 WAY STOP VALVE
10" PIPE
TOP OF 20" I BEAMS
℄ BURNERS
14'-0"
4'x6" INSP. DOORS
TOP OF 20" I BEAMS

Fig. 10. How a 600-hp office building boiler furnace was enlarged for pulverized-coal firing by deepening furnace and sloping rear wall. In the original setting for oil firing, the furnace bottom was level with the operating floor

Bomb-Proof Construction of Utilities

A short but rather detailed account of different types of construction used in bomb-proof power plants as well as other utilities. There is a difference between bomb resisting and bomb proofing. The latter is extremely costly and often is possible only in locations where the natural conditions permit it.

By BILL MADDOCK

ALTHOUGH the possibilities of bombing attacks by the enemy in this country are rapidly becoming more remote as the United Nations gain in strength, there is, nevertheless, a certain interest in the design of bomb-proof structures in certain areas, particularly in our island possessions. POWER PLANT ENGINEERING has given some attention to this problem in the past and the purpose of this short discussion on the subject is to outline the character of some recently planned bomb-proof designs.

Most of such present installations are in connection with the development of Army, Navy, Marine and Air bases, and range in magnitude from telephone booths to the gigantic storage of 6,000,000 bbl of oil. In each and every one of these cases there had to be a decision as to the degree of protection desired. Obviously, with enough time and material, complete isolation and protection could be built that would withstand any known force of destruction. The degrees of the desired protection might be classified as:

1. Splinter Proof. A building that could stand a near miss, shrapnel, and small calibre guns.
2. Bomb Resisting. A structure that could take one direct bomb hit and absorb the pounding of a 3 or 4 in. gun.
3. Bomb Proof. Buildings so covered that no known bomb or series of bombs could cause internal damage.

Nature plays a big part in the determining of the amount of protection. Places of flat terrain, low elevation, and close surface water do not lend themselves to complete bomb-proofing. For this reason, underground airplane hangars and other large scale installations will in all probability be located near sharp rising buffs.

Reinforced concrete is the present favorite material for construction. One type of bomb-resisting structure is being built of layers of concrete slabs four to six ft thick separated by about six ft of air space as in Fig. 1. The theory is that should a bomb make a direct hit, it would penetrate the top layer by impact or kinetic force alone before the explosion had time to take place. The resulting explosion would then dissipate its energy in the air space without disturbing the lower layers. Quite surely, two or three hits in the same place would break through, hence such structures are only bomb *resisting*.

True bomb proofing calls for great depths of earthen overburden or very expensive superstructure. One of the largest of these projects resembles a large mine. In fact it was made by mining methods. The usual shafts were drilled down to intersect lower level tunnels and conveyers in these tunnels carried away the material removed from the "hole" as the shafts were enlarged to make vast rooms underground. After the rooms were of proper size they were lined with reinforced gunite to hold and seal loose rock fragments and to give a smoother interior. See Fig. 2.

There are many bomb-proof power plants in Europe but to this writer's knowledge there is only one in the United States. The Utopian plant would fulfill the following requirements:

1. Take no outside source of power for starting.
2. Require minimum fuel storage.
3. Require no outside facilities such as water lines, cooling tower, stacks, etc.
4. Be simple in operation.
5. Be centrally located to reduce the vulnerability of the distribution system.
6. Require minimum ventilation so as not to be too open to "gas warfare."
7. Be large enough to supply the vital needs of power.

The answer to all of these appears to be a hydro plant that could secure its water from an adjoining source. Picture Niagara's power plant placed in a

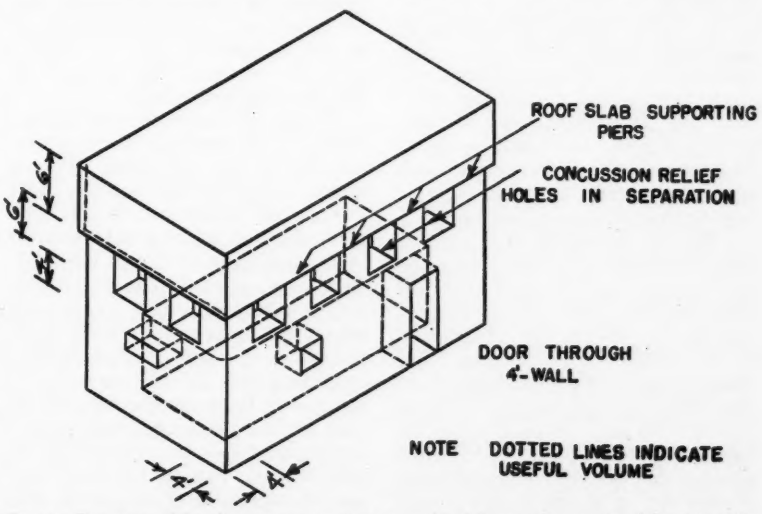

ROOF SLAB SUPPORTING PIERS
CONCUSSION RELIEF HOLES IN SEPARATION
DOOR THROUGH 4'-WALL
NOTE DOTTED LINES INDICATE USEFUL VOLUME

Fig. 1. One type of bomb-resisting structure is made of layers of concrete slabs 4 to 6 ft thick separated by about 6 ft. of air space

vast recess in the bluff at the base of the falls with the penstock running up to a tap in the bottom of the river and it would serve as a good example. But not many of these ideal locations are at the same spot where positive sources of power are necessary.

Secondly in order of meeting these requirements is the gas or "combustion turbine." Fuel storage and ventilation needs keep it from being perfect but it has the advantages of being simple, quick starting, and has no particular large cooling problem. Unfortunately it has not been used as much during this period as it could be, because of its "newness" and because many men in high positions have never heard of them. This writer is not too sure but it would seem that for equal capacities, the weight of metal and the man hours of production would be less for a combustion turbine than for a diesel and all its auxiliaries. If so, it is unfortunate that they have not been given more consideration.

The highly favored "old faithful stand-by diesel" comes third in the list when considered in the light of the Utopian. Besides having to have cooling water, ventilation, and oil purification, the pulsations seem to be magnified in the dome type rooms usually made for housing underground installations. Its popularity is based on the diesels' reputation gained as an economical stand-by. In this type of service the efficiency is important only inasmuch as the fuel storage has to be larger as the efficiencies go down.

A steam station with its stack, excessive cooling water needs, the largest fuel storage requirements, high ventilation needs and slow starting characteristics is very poorly suited to bomb-proof or bomb-resisting construction and operation. The physical size is also against the use of steam.

In the previous paragraphs there have been references to the ventilation requirements of all the different type units. In normal plant design the ventilation is a minor consideration, and there is little or no concern about the possibility of having to "condition" the air. During a gas attack the operators could shut down a gas turbine, or diesel completely but a steam boiler would have to be supplied with air to remove the heat of radiation. In actual operation there is not much to choose on this count alone except hydro plants. For diesels or gas turbines the air supply should be from 3 to 5 cfm per horsepower capacity, and for steam the figures would run from 4 to 6 cfm. Radiation from the boilers, engine jackets, and generator coils might run 20 per cent of the net output or roughly 680 Btu per hr per kw capacity. Allowing as much as a 30 deg rise in the air temperature, it would take about 21 cfm per kw capacity. This figure and the air requirements for the burning of the fuel are not necessarily additive because the combustion air could very well be a part of the air supplied for ventilation. It appears that a minimum of about 20 cfm per kw capacity is necessary. In the supply ducts as well as the vent there should be concussion baffles. The inlet and outlet shafts should be well separated to give an extra access in case one is closed from debris. Of course one of these has to be large enough to get the largest piece of equipment in, so its baffles have to be installed the last thing.

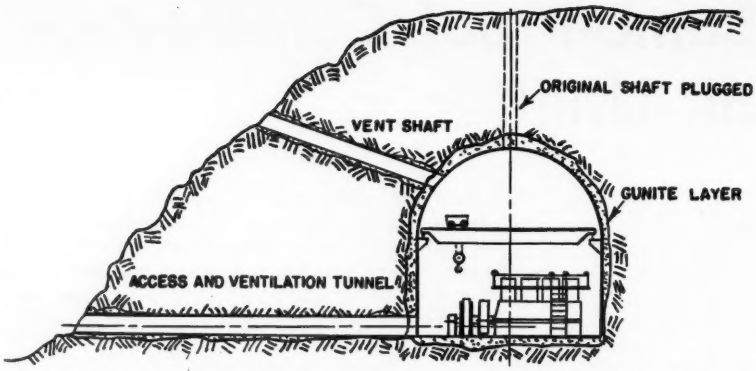


Fig. 2. This type of bomb-proof plant resembles a mine, in fact it is made by the use of mining methods

Water works are better adapted to bomb proofing than power plants. In the first place, it is not uncommon for the motors and pumps to be placed below the ground level, leaving only a small meter and control house exposed. This arrangement places the major machinery away from the forces of destruction, and, since metering is only a very minor consideration in an emergency, the power lines are the only thing that could be damaged that would stop operation. In most instances the service can be quickly repaired, so wells of this type are fairly bomb proof. One of the most unusual and best protected water works is the Phelps-Dodge well at Ajo, Arizona. In this installation the pumps, motors, controls, and valves are all a few hundred feet below ground level. It is no small station, either, for it supplies all the water for a 24,000 ton per day copper industry as well as the townsite. The worst thing that could happen to the well would force a water shortage of not more than 36 to 48 hr. It was not intended as a bomb-proof plant but only as a feasible water development in a dry country, but it is one of the best protected.

All in all the construction of bomb-proof utilities is very expensive. A 3200 kw diesel power station complete with auxiliary lighting, pumps, and cooling water supply costs well over a million dollars or more than double the usual cost. The major part of this cost is made up of the extra strength of construction required and the amount of excavation that is required. All economies have to be sacrificed for safety. For comparison, take the cost of a machine replacement. The two machine construction jobs take very skilled labor, vital materials, and, most important, take machine tool time. On the other hand the building of the bomb-proof building goes on at the same time as the machine is being built and with less skilled labor, with somewhat less vital material. Neither will two plants, even separated to some extent by time or distance, really assure that one of the two would come through unharmed. In the light of present construction in possible combat zones, it would seem advisable to spend even three or four times the usual amount if it could assure "finger tip" power at the vital time.

Chemical Removal of Scale*

Removal of scale by chemical means from boilers and other heat-exchange equipment has been made practical and safe by the recent development of inhibitors used with hydrochloric-acid-base solvents. Contributing to the success of the art are methods of scale sampling, X-ray analysis of scale, selection of solvent and the development of treating equipment and the technique of its industrial application

By F. N. Alquist, C. H. Groom of Dow Chemical Co.
and
G. F. Williams of Dowell Incorporated

REMOVAL of surface scale from iron and steel by immersion in acid is an old art which owes its growth to the discovery that the addition of certain materials called inhibitors practically prevents attack on the base metal but permits fairly rapid solution of the scale. Recent discoveries have produced several exceedingly potent inhibitors, each appropriate for the particular type of work for which it was devised.

Inhibitors alone, however, do not make a good scale solvent. Other agents must be added to the inhibited acid to adapt it to the particular type of scale to be removed.

Research on the use of inhibited acid has continued, with the result that in the last few years inhibitors have been developed for almost every type of metal normally utilized in the construction of heat-exchange equipment at various acid concentrations, temperatures, and time intervals. This research program has developed a knowledge of what types of metals can be safely contacted with inhibited acid, which makes it possible to remove scale deposits from heat-exchange equipment with chemical solvents.

Sampling of Scales

A solvent treatment for the removal of scale is based upon the particular scale to be removed. Naturally, the scale sample is very important and should be representative of the scale in the equipment. It should be taken from surfaces where it is the most difficult to remove. A scale sample from a boiler should represent the hardest, most dense scale found in the boiler and probably should come from the hottest tubes.

Scale samples from condensers and similar equipment should come from near the inlet where the heaviest deposits are formed. The sample should represent the deposit down to the bare metal. The preferred type of sample is a small section of tube or pipe containing the scale; however, as in most cases this is neither necessary nor practical, chunks of scale are most frequently obtained and are adequate. Powdered scale in most instances is sufficiently satisfactory, but chunks of scale make the design of a treatment more certain.

Table I. Scales from boilers[a]

Compound	Percentage of scales containing compound	Percentage of scales containing compound in concentrations indicated: 1–25 per cent	26–50 per cent	51–75 per cent	76–100 per cent
$CaCO_3$	54	31	15	23	31
Silicates	41	67	15	0	18
$Ca_{10}(OH)_2(PO_4)_6$	33	20	30	8	42
Iron oxides	32	40	29	14	17
$CaSO_4$	28	20	16	17	47
$Mg(OH)_2$	14	33	47	20	0
$Ca(OH)_2$	1	100	0	0	0

[a] Scales from boilers have been analyzed and tabulated to show the types of scales predominant in boilers.

Table II. Scales from condensers, evaporators, and heat-exchange equipment[a]

Compound	Percentage of scales containing compound	Percentage of scales containing compound in concentrations indicated: 1–25 per cent	26–50 per cent	51–75 per cent	76–100 per cent
$CaCO_3$	54	33	27	3	37
Iron oxides	54	17	13	17	53
$CaSO_4$	18	20	30	30	20
Silicates	18	40	40	0	20
NaCl	7	75	25	0	0
$Mg(OH)_2$	7	50	25	0	25
Sulphides	5	67	0	0	33
$Ca_{10}(OH)_2(PO_4)_6$	4	50	50	0	0

[a] Scales from condensers, evaporators, and heat exchangers have been analyzed and tabulated to show types of scales predominant in this type of equipment.

X-Ray Analysis of Scale Samples

The scale sample is first examined for its physical characteristics, such as density, porosity, thickness, manner of formation, etc., and whether it appears to consist of more than one type, as is usually the case with scales composed of different layers. After this general examination, the chemical compounds composing the scale are identified by means of X-ray diffraction patterns. This method of analysis results in the determination of actual compounds as they exist in the scale, which is not possible by other analyses.

The specimens are powdered and loaded into capillary tubes, inserted in the camera, placed on the diffraction unit, and exposed for 6 hr at 30,000 v and 20 ma. Development of the films requires about 1½ hr. The diffraction pattern on the developed film is then compared with patterns of known crystalline substances, thousands of which are available in a comprehensive filing system much like a fingerprint file.

Some of the advantages of the X-ray method of analysis are as follows:

1. Substances are shown in their true state of chemical combination.

2. The analysis is conclusive, even though only small amounts of material are available. This is valuable for scale studies, where it is sometimes quite difficult to obtain a large sample without dismantling the equipment.

3. Samples are analyzed as received and are not destroyed.

4. Preparation of sample and procuring of the pattern are simple and economical.

5. A permanent record of data is always on file in the form of the pattern.

6. The analysis is quickly and cheaply made. This is of importance when time and expense are controlling factors.

At the present time, X-ray diffraction gives a semiquantitative analysis. The accuracy varies widely but usually allows a determination to within 5 per cent of the amount present.

*Abstracted from paper delivered at the Spring Meeting of the ASME, April, 1943.

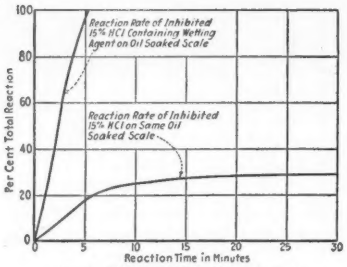

Reaction Rate of Inhibited 15% HCl Containing Wetting Agent on Oil Soaked Scale
Reaction Rate of Inhibited 15% HCl on Same Oil Soaked Scale
Per Cent Total Reaction
Reaction Time in Minutes

Fig. 1. Effect of Wetting Agent

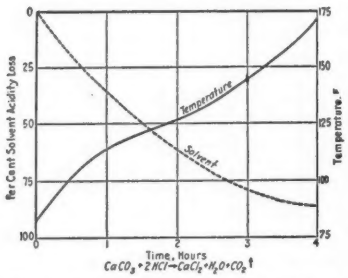


Fig. 2. Solvent strength during treatment

Sometimes a scale is encountered which gives a diffraction pattern which does not match any of the reference patterns. In these instances the X-ray analysis is supplemented by a spectroscopic analysis which shows semiquantitatively the metallic elements present. Whether the metallic elements are combined or uncombined makes no difference as the total amount is obtained.

Tables I and II show the compositions of scales found in various heat-exchange equipment.

Selection of Solvent

From the physical and chemical characteristics of the scale, the various solvents suitable for dissolving and disintegrating that type are readily selected.

The usual solvent base is muriatic acid, which is rendered noncorrosive by the addition of special inhibitors applicable for the particular metals and scales to be encountered. To this acid are then added catalysts, wetting agents, intensifiers, reaction-control agents, etc., to adapt the solvent to the scale to be treated. Different scales require different auxiliary chemicals, which fact accounts for the importance placed upon the identification of the scale. Figure 1 shows the effect of a wetting agent.

Solubility determinations are then made under varying conditions similar to those to be encountered in the treatment. Time, temperature, and the manner of application of the solvent are all considered. These tests not only verify the choice of solvent make-up but they also indicate the best treating technique.

Treating Technique and Equipment

The equipment available for the chemical cleaning of heat-exchange equipment is the result of years of experience in the chemical treatment of oil wells. Motorized units are equipped with large metal tanks for transporting the necessary chemicals and pumps for pumping the prepared solvent into the industrial equipment to be cleaned. Each treating unit has a proportioning apparatus for diluting the solvent with water which is obtained on the premises and also apparatus for adding auxiliary chemicals. In this manner, the awkwardness of handling acid in glass carboys and the need for mixing tanks are eliminated. A heater which raises the temperature of the prepared solvent is also part of the equipment.

In removing scale from a heat-exchange unit, the unit is taken out of service, drained, and isolated from all portions not to be cleaned, by closing all connecting valves or blank-flanging piping. Prepared solvent at the prescribed temperature is pumped into the unit through one of the lower connections until the unit is full. The solvent may then be circulated continuously, intermittently, or allowed to stand according to the treatment prescribed.

Samples of solvent for strength and temperature determinations are taken at regular intervals as the treatment proceeds. With scales of calcium carbonate or similar types, the solvent strength indicates when the scale is all removed, Fig. 2.

When the solvent treatment is finished, the solvent is drained to the sewer and all traces of solvent flushed out of the treated equipment with water. The water flush is often followed by an additional chemical neutralizing solution. After inspection, the unit is ready to be put back into service.

Limitations of Chemical Cleaning Methods

Naturally, most mechanical engineers have had little experience with chemical cleaning methods. As the materials used are reactive and in concentrated form, they must be properly handled. Experience in this field is advantageous. Power plant engineers depend upon their chemists for guidance in handling chemicals.

All types of scales cannot be readily removed, and it is therefore necessary to determine the composition of the scale before treatment. The types of scales difficult to remove are calcium sulphate, certain silicates, and some refinery scales. However, scales containing certain percentages of calcium sulphate, and about 80 per cent of the silicate scales encountered may be satisfactorily removed.

Advantages of Chemical Cleaning

The advantages of the chemical cleaning method include:

1. Outage time is materially reduced.

2. Dismantling operations are eliminated, since solvents can circulate through existing connections and penetrate wherever steam and water flow, cleaning all inaccessible locations. This is of considerable importance as much equipment is being designed for maximum economy and efficiency rather than accessibility.

3. No extra labor or equipment is necessary.

4. Equipment replacements, such as gaskets, turbines, etc., are greatly lessened.

Failure of Fusible Plugs

FUSIBLE PLUGS fitted in steam boilers are not only liable to drop out through water shortage but may fail through corrosion of the plug.

Corrosion may occur on either the water or fire side of the plug, the former through the action of the boiler water and the latter through the action of the furnace gases. If the plug is badly fitted or is cracked so the water can leak through into the furnace, the water, coming in contact with the furnace gases forms an acid solution which quickly causes serious corrosion and in time will cause the plug to fail.

Furnace gases are always more or less corrosive when in contact with moisture. When dry, they do not cause corrosion, as moisture is needed to make them active. Corrosion on the water side is caused when the feedwater is highly alkaline or contains other impurities.

The body of the plug should be made of a metal suitable to withstand the action of the boiler water; not all metals are equally satisfactory when used with various boiler waters.

It is to be recommended that the fusible core be renewed annually and that every two years the entire plug be removed and given the complete examination which is not possible when in position.

Selection and Maintenance of Speed Reducers

By FRANCIS A. WESTBROOK

MODERN SPEED reducing units offer many advantages in simplifying the layout and reducing the maintenance of both power-producing and power-using equipment. These, compact, self-contained units are effective, flexible, and, as a rule, are easily applied to a wide variety of uses. The following examples, taken from actual practice, will emphasize some of these points.

The first case is illustrated in Figs. 1 and 2. This drive is for a rotary kiln 60 ft long and 6 ft in diameter making one revolution in 90 sec. Originally the drive consisted of a 20 hp, 1200 rpm motor arranged as shown in Fig. 1. The reduction in speed was accomplished by the use of two flat belts, one bevel gear and two reductions by open spur gears. This drive, obviously, required considerable space, was exposed to dust and dirt as were the bearings of the pulleys and gears and constituted a hazard from the standpoint of safety. Obviously considerable maintenance was necessary to keep the equipment in satisfactory condition. The modernized drive is shown in Fig. 2. This involved the installation of a 5 hp, 1750 rpm motor with a triple-reduction herringbone gear speed reducer. The outboard end of the reducer output shaft was supported by a roller bearing pillow block for a roller chain drive from this point to the pinion shaft of the rotary kiln. A flexible coupling was installed between the motor and the reducer shaft. With this arrangement it is plain that there is a substantial saving in power and, as all but the most slowly moving parts are enclosed, there is a reduction in wear and tear, maintenance and accident hazard. The new drive is also very compact and saves much floor space over the old one.

The herringbone gear speed reducer is applied, generally speaking, for transmitting the larger blocks of power, or where it is advantageous to introduce a roller chain into the drive for the sake of flexibility, or saving in cost. It will be worth while to give brief consideration to a few practical situations where the roller chain may be advantageously associated with the herringbone reduction unit.

A good example is where there is a motor drive to a lineshaft operating, say, at 70 rpm, the power to be transmitted being 150 hp. With V-belt, flat belt or chain drive direct from the motor the speed of the latter would have to be 570 rpm. If, however, a single reduction herringbone gear is used with a flexible coupling between motor and reducer, and a roller chain from the output side of the reducer to the lineshaft, a motor with a speed of 1750 or 1150 rpm may be used. This has the advantage of compactness, easier installation, more flexibility as to the placing of the motor, a less expensive motor and installation costs, the possibility of changing the lineshaft by changing the sprocket ratio, etc. The last mentioned feature of flexibility with regard to changing the speed is, of course, especially desirable at this time of rapid plant expansion, revamping of layouts and other changes incident to the great increase of production, with existing equipment insofar as practicable.

It is also often possible to use a smaller reducer by the interposition of a roller chain between reducer and driven equipment. If the drive is direct-connected it is necessary to have flexible couplings between the motor and the reducer, and between the reducer and the driven machine. Of course the reducer must be large enough to take care of the whole reduction in speed. Also, a base large enough for the two is another obvious necessity and there is a minimum of choice as to the location of the drive equipment. If, however, part of the reduction in speed is accomplished by having a roller chain between the output end of the reducer and the machine it is possible to have a smaller, less expensive reducing unit, and to do away with the flexible coupling. There is then much more choice as to placing the motor and reducer with respect to each other, as well as the possibility of changing speed ratios by changing the chain sprockets. Such an arrangement has the additional advantage that a split driven sprocket may be

Fig. 1. Cement kiln drive as it was originally

Fig. 2. The same kiln but with the new drive

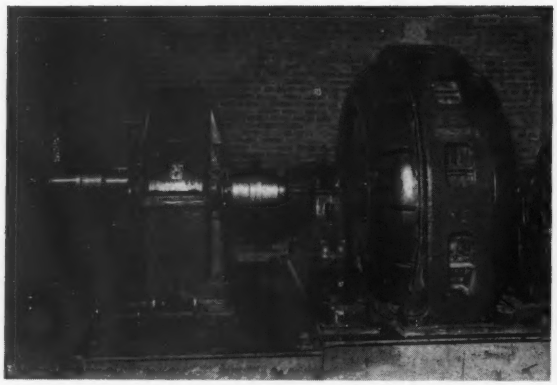


Fig. 3. A 714 rpm synchronous motor driving a line shaft at 182 rpm through a herringbone gear reducer

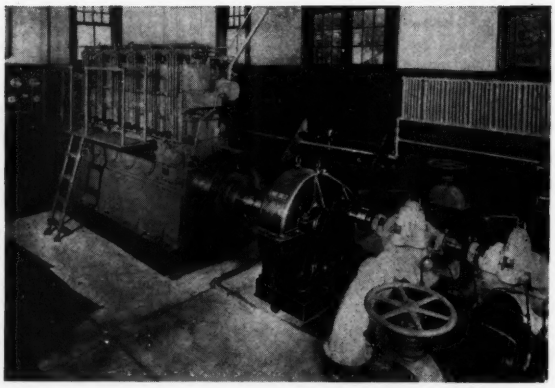


Fig. 4. Speed reducer serving as a speed increaser between a Diesel engine and centrifugal pumps

used and attached at any convenient point on the lineshaft, for instance, thus entailing a minimum disturbance of existing equipment.

Other examples of the flexibility and various advantages possible by combining speed reducing units with chain drives might be given, but the foregoing should be enough to indicate what can be done. Much depends on the imagination and ingenuity of the plant engineer. Under present conditions, where means must be employed to provide for quick and unpredictable expansion, these comparatively simple arrangements become of a great deal of practical importance. Figure 3 shows an interesting, clean-cut, large power drive of the direct-connected type. This consists of a 720 hp, 714 rpm synchronous motor direct-connected to the end of a lineshaft 112 ft long in a brick plant and operating at 182 rpm. The speed reduction is obtained by means of a herringbone gear reducer with a flexible coupling on each side as shown.

Speed increasing units using the herringbone gears are coming into more general use for driving blowers, centrifugal pumps, high speed generators, compressors and other high speed equipment where the speed of available prime movers is not sufficient. Such increaser units make practicable the use of prime movers of standard design. Figure 4 shows a speed reducer serving as a speed increaser between a Diesel engine and a series of centrifugal pumps. This installation is in the Manhasset-Lakeville Water District plant on Long Island, N. Y.

Speed increasers essentially have the same features as reducers. Their application to slow speed Diesel engine drives has been found particularly useful, and, of course, for occasional motor drives.

Worm gear speed reducing units present advantages similar to those enumerated for the herringbone type. They are extremely compact and are most practicable for the smaller drives usually not exceeding about 25 to 30 hp. This type of reducer is usually applied for large reductions. Final chain drives are as frequently used as with herringbone reducers. Figure 5 shows a worm gear speed reducer in the drive for a skin drying conveyor head shaft in a tannery. It consists of a motor, a 60 to 1 ratio reducer and 18 to 80 tooth ratio roller chain.

Speed reducers of both types are designed for various ratios, and of course for the different amounts of power to be transmitted. As a general thing the high speed shaft is designed for direct-connection, through a flexible coupling, to the motor or other prime mover; the low speed shaft is designed for both direct-connection and moderate over-hang loads, commonly referred to as torque application units. They are also available for heavy overhang loads with larger diameters and heavier bearing construction. For extremely heavy outboard loads an outboard pillow block can also be provided. Whenever there is any doubt regarding design or type requirements, as when an application is being contemplated which is new in the plant, the engineer may save himself a lot of trouble by consulting with one of the reliable manufacturers of this kind of equipment.

The maintenance of speed reducing equipment is decidedly simple. The housings of the units are dustproof and oil tight, which makes it unnecessary to change oil more than about twice a year, depending on the daily hours of operation. An easily observed oil level indicator shows at a glance if more lubricant is needed. The grade of oil which should be used depends mainly on the room temperature.

(NOTE: All photographs used in this article were supplied through the courtesy of Link-Belt Co.)

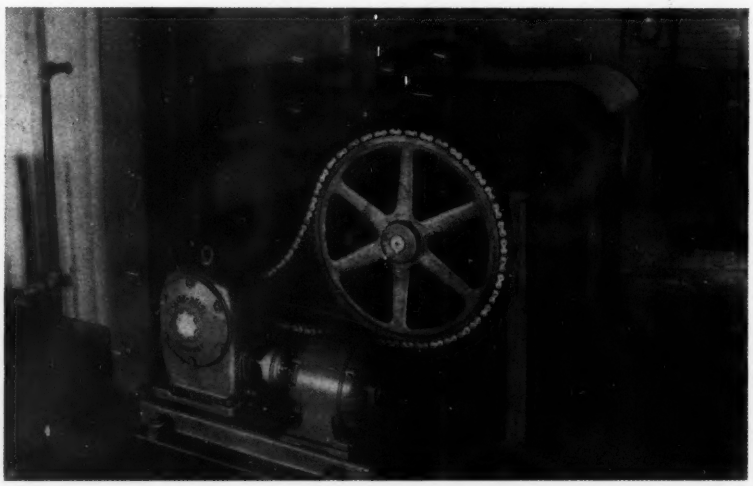


Fig. 5. Worm gear speed reducer driving a drying conveyor in a tannery

Keep Them Pumping

Part II. In this second and last installment of the series dealing with inspection and care of pumps, the author stresses the importance of proper packing, its care and replacement; he also cautions the operator to make certain the liquid is always available, piping correct, that starting and stopping is properly done and that the pump has been suitably chosen for the job it is to perform in the plant

By J. O. Glenn, Standard Products Division, Worthington Pump and Machinery Corp.

PACKING METHODS and stuffing box operation are the subject of considerable discussion among maintenance engineers, since packing, wrongly selected, improperly applied or improperly serviced, has caused the replacement of too many parts and too much attention from a busy operator.

The grade of packing for each application should be selected carefully according to the recommendations of a reputable packing manufacturer. The following comments on the selection and application of packing apply generally to pumps handling non-corrosive or non-volatile liquids at moderate pressures.

For a rotating shaft, such as on a centrifugal or rotary pump, a square braided soft graphited asbestos packing will give good service. Flax packing used on a rotating shaft is likely to result in grief in the form of a badly scored bronze sleeve. For piston rods and outside packed plungers, a square braided flax packing is acceptable. Water pistons are usually packed with fibrous non-metallic packing, with rings moulded or cut to size, stocked by the pump manufacturer.

In servicing stuffing boxes, cleanliness is the first consideration. The insertion of new clean packing in a stuffing box where there is even a small accumulation of dirt and grit is just inviting trouble. Likewise the use of packing that has been stored carelessly is also a mistake. Extra packing left in the open will gather dust and grit which cannot easily be removed. Such neglected packing is better off in the trash can where it cannot ruin a rod, shaft or sleeve.

All packing should be inspected at regular intervals and replaced when there are indications that it is losing its lubricating qualities or becoming hard. When repacking a stuffing box the rings of packing should be cut with a sharp knife and on a clean surface. When a ring is wrapped around a shaft or a rod it should be butted accurately to prevent buckling. The rings, with joints staggered for sealing, should be inserted in the stuffing box and carefully pressed, not forced, into place one at a time all the way in. The gland should be pulled up evenly with a wrench until it is tight, backed off and then taken up with the fingers. This will allow a little leakage required at every packed stuffing box to prevent the generation of injurious heat.

In repacking a pump stuffing box having a lantern gland or seal cage, care should be taken to see that the seal cage lines up with the inlet hole in the stuffing box. When only one or two new rings of packing are installed to compensate for compression or wear, it must be remembered that the seal cage may have been moved away from the seal inlet. In the installation of such additional packing rings care must also be exercised if the stuffing box contains a packing combination designed for a special service and having rings of several different compositions.

A water piston packed too tightly will result in rapid wear of both packing and cylinder liners. This is a common condition on pumps handling hot water which will cause the average packing rings to swell and bind after a period of service. It is well to soak the new piston packing in warm water over night before installation. If the rings become too large they may be corrected by stripping a layer from one side, or hammering if the ring is of the braided type, as the swelling is usually lateral. The packing must have clearance in the space both in depth and length as illustrated by Fig. 1. When the piston is moving as shown the discharge pressure is exerted on the back of the packing rings holding them firmly against the liner. When the piston reverses the packing shifts to the opposite end of the space. With this arrangement the pressure on the packing is proportional to the working pressure of the pump, no more than absolutely necessary.

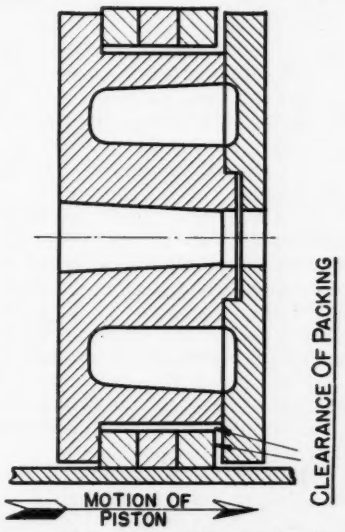


Fig. 1. Water piston packing requires clearance in two directions

Centrifugal pump shafts operate at high speeds; and no packing material, without a protecting film, can contact the shaft under pressure without generating heat which will eventually destroy any lubricant in the packing. One function of a stuffing box seal cage, Fig. 2, on a centrifugal pump is to prevent the infiltration of air when the pump operates under a suction lift. Another reason for a seal cage, however, is to protect the packing and shaft from damage. Usually a centrifugal pump, when shipped from the factory, is provided with a connection from the casing to the

stuffing box seal cage. This will take care of average conditions, there being clear, cold water in the pump casing under sufficient pressure to force a protecting film of liquid between the shaft and all of the packing in both directions.

On the following operating conditions, however, the conventional arrangement is entirely inadequate; and the seal cage connection at the stuffing box should be piped to an independent supply of cold, clean water at a pressure from 15 to 40 lb per sq in.

When the pump operates with a suction lift and the discharge pressure is less than about 10 lb per sq in. equivalent to a head of about 23 ft.

When the water pumped is at a temperature exceeding 200 F.

When the water pumped is muddy, sandy or gritty.

In general, when the liquid handled is other than water, such as fruit juice or substances that become sticky when drying.

On all condenser hotwell pumps.

When a centrifugal pump is operating with pressure on the suction side, and it is difficult to control excessive stuffing box leakage without frequent packing adjustments, the seal cage is serving no useful purpose. It is just as well to remove the seal cage and its piping entirely, plug up the connections and fill the space with that much extra packing.

Stuffing boxes on pumps handling chemicals, light distillates, etc., or on high pressure hydraulic service usually require special consideration on the part of the pump or packing manufacturer. Recommendations will vary according to the character of the liquid, the temperature, the pressure, and other operating conditions.

The principal guide in packing maintenance is to remember that a dry stuffing box is surely breeding a headache.

Are All Pumps Always Assured of a Supply of Liquid When Operating?

All pumps depend, to some extent, upon lubrication from the liquid handled. Serious damage can occur if a pump is operated without its liquid supply.

In a centrifugal pump the wearing surfaces between the impeller hub and the casing rings, if dry, are quite likely to heat up,

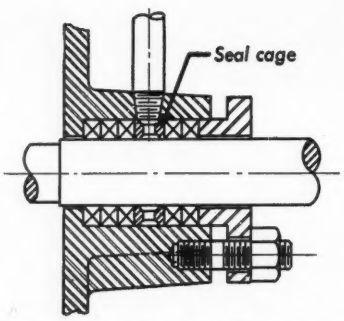


Fig. 2. Cross section of stuffing box seal cage for a centrifugal pump

seize and cause extensive damage. Running a rotary pump dry will inevitably lead to galling, seizing or destructive wear between the rotors, end plates and casing. Since most rotary pumps are of the internal lubricated type, depending entirely upon the liquid pumped for lubrication, dry bearings may be added to the list of casualties. In virtually all cases a pump designed to handle liquid, but operated dry, will soon be unfit for duty with dried out or charred packing and scored adjacent parts such as shafts, shaft sleeves, rods or liners.

This calls for a periodic check of all priming devices, particularly those on automatic systems, where the operator is unable to make sure that immediately after each start the pump actually pumps liquid and doesn't just fan or push air.

Can Operation Be Improved with Minor Piping Changes?

Misalinement, overloads, shocks or vibration, premature wear due to the presence of foreign particles in the liquid and the harmful effects of a pump running dry because of loss of prime are all commonly traced to errors of commission or omission in the installation of piping.

The size of the pipe openings on a pump are not necessarily the correct size for the pipe. This is particularly true of centrifugal pumps where the required pipe size for a system is generally larger. The correct size of pipe can always be determined from pipe friction tables which are published in the literature of many pump manufacturers.

All piping should be as short and direct as possible, and rigidly supported to relieve the pump from strains. Gate valves, with unrestricted passages, are preferable to globe valves. A check valve on the discharge side of the pump will protect it against return surges.

Air pockets or high spots in a pump suction line will invariably lead to trouble. Every pump should have its individual suction pipe to the source of supply; and to insure an ample supply of liquid free from air, the intake end of the suction pipe should be submerged from 2 to 5 ft, depending upon size, below the low level of the supply. For suction lifts in excess of 8 ft, for long suction lines or for large pumps a foot valve of ample area is desirable for quick starting. If there is a possibility of pressure building up in the suction line due to any contingency a small spring relief valve set at a pressure of about 25 lb per sq in. should be installed in the suction line when a foot valve is used. If there is a possibility of the liquid containing foreign matter that might damage the pump, a strainer, four to five times the area of the suction pipe, should be used.

A spring relief valve should be placed next to the pump in the discharge line of every positive displacement pump of the reciprocating or rotary type. This relief valve, set to open at a pressure slightly above the operating head, will protect the pump against damage due to possible closing of the main discharge valve. Every pump of this type should also be provided with a manually controlled bypass from discharge to suction for use in starting, especially when the pump is started against full load.

When changes are made in suction piping or new suction piping is installed, failure to make sure that the interior of the pipe is absolutely clean has created many a pump repair job.

A few minor changes in piping, the addition of a few safety features and a scheduled inspection of strainers, foot valves, check valves and relief valves will go a long way toward reduction of maintenance materials.

Is Care Exercised During Shutdowns and When Starting?

During shutdowns the casings or cylinders of all pumps handling water should be drained, particularly during cold weather. Further, any pump handling a heated, highly viscous liquid or a corrosive liquid should be drained and flushed out. A cold viscous liquid in a pump, when starting, means a serious overload; and traces of

(*Continued on Page* 120)

The PRACTICAL ENGINEER and ELECTRICIAN

ANDREW W. KRAMER, EDITOR

WANTED, MORE EFFECTIVE GROUSERS

The chronic grouser who is always finding fault with things as they are is usually not accorded much sympathy but now it appears his grousing is somewhat of a blessing in disguise. As disclosed by Charles R. Riker who is the suggestion system coordinator for Westinghouse, if the grouser can be made to carry his criticisms to a point where any ideas in these criticisms can be put to effective use, he becomes an asset. According to Mr. Riker, American war industry must get production ideas from the men and women down in the shop in order to send the armed forces sufficient equipment for final victory. The ordinary workman through a good suggestion system can be of very great help in solving the problem of production. The typical American said Mr. Riker, is a chronic grouser. In the Army, this trait is recognized and encouraged because his grousings often have concealed merit. Developing a good suggestion involves merely turning a grouse into a constructive idea. Grousing involves finding fault with an existing condition, method or operation and all that is needed is to develop a practical means of overcoming present defects or limitations. The trouble is that most people stop at the initial fault-finding stage. They should be encouraged and shown how to take the second constructive step which leads to good suggestions. So if you have any kicks, don't make them where nobody of importance can hear them; polish them off a little and take them to the boss or to the suggestion box if there is one.

A.W.K.

CONTENTS

The Amplidyne—What It Is and How It Works **78**
By Fremont Felix

It May Be Hard to Get but Have You Tried the Plant Itself? **80**
By Frank V. Faulhaber

Why Bearings Fail **81**
By C. A. Comstock

Data on Belt Loadings **83**

Oil to Coal Conversion **83**
By S. H. Chapman

Simplifies Small Wire Soldering **83**

How Would You Do It? **84**
Problem 28. Our Hero Runs into a Wiring Problem
Problem29. Eliminating Moisture from a Paint Spray Compressed Air Line

Letters and Comments **88**
From Malarkey's College of Practical Knowledge
This Started It
Priorities Lead to Water-Cooled Valve
It's in His Blood

Questions and Answers **92**
Who Has a Work Schedule for a 6-day Week?
How Much Inductive Kick Current Will He Get?
This Engine Pulls Water Out of the Boiler
Are His Heating Lines Filled with Scale?
Examination Questions: Who Can Answer Them?
Is a 10-amp Fuse Always a 10-amp Fuse? Well—See Watt George Started! ! !
Why Do Fans Act This Way if Discharge Is Obstructed?

Chart Giving Comparative Fuel Costs **100**

A Section of Power Plant Engineering Devoted to PLANT OPERATION AND MAINTENANCE

Technical Publishing Company
53 West Jackson Blvd., Chicago, Ill.

THE AMPLIDYNE—*What it is and How it Works*

By FREMONT FELIX

Industrial Engineering Division
General Electric Company

Much has been published regarding the accomplishments of the Amplidyne, but relatively little about how it works or what it can do. In April 1940 we presented a comprehensive article describing its development and theory, but several years have elapsed since then and we feel that many people who may have heard of the Amplidyne still do not have an adequate idea of what it is. Accordingly we take pleasure in presenting this simple explanation by Mr. Felix for the benefit of the practical man in the plant. The Amplidyne, as its name indicates, is an amplifier, but it amplifies without the use of electron tubes. It is, what may be called an electro-dynamic amplifier. Mr. Felix shows step-by-step, what the Amplidyne is and how it works

ONE OF THE MOST IMPORTANT electrical developments of recent years is the Amplidyne, a product of G-E engineering which is being applied with numerous advantages to a growing list of duties. Since its first application in the late 1930's it has improved many existing electric applications and made others practical which were not practical before.

At every step of the way, from the mining of raw materials to the final processing of a wide variety of products, Amplidynes are helping set new highs in production and new standards in quality. Applications include mine hoists and power shovels, blast furnace skip hoists, electric furnaces, blooming plate, and cold strip mills, runout tables, flying shears, electrolytic tinplating lines, saw mill carriages, boring mills, and paper machines.

In these and in many other applications, the Amplidyne is proving its versatility by performing a wide variety of functions, as follows:

1. It controls speed accurately over a wide range;

2. It limits loads to protect electrical and mechanical equipment;

3. It controls torque and tension to improve product uniformity in winding, drawing, and other similar operations;

4. It speeds up acceleration and deceleration to increase production of high-inertia machines;

5. It positions machine-tools, arc-furnace electrodes, simply and precisely;

6. It regulates current, voltage, power, speed;

7. It can be used with either a-c or d-c equipment;

8. It is a natural partner of electronic devices.

The Amplidyne is an externally-driven d-c generator, outwardly similar to a conventional motor or generator. But its ingenious and unique use of a short circuit and compensating winding creates such precise electrical balance that an electrical signal as small as half a watt will instantly release kilowatts of power capable of controlling the most powerful electrical machine. Figs. 1 through 5 explain this unique principle of the Amplidyne.

A conventional two-pole 10-kw, d-c generator driven at constant speed may be shown schematically as in Fig. 1. For the sake of simplicity, the armature is shown serving also as commutator and a single exciting field coil is shown on the north pole. The small circles with dots show conductors where the current is directed towards the reader and the small circles with arrow tails show conductors where the current is directed away from the reader.

About 100 watts of excitation power supplied to the field coil creates the excitation flux. This flux is producing a full-load voltage of 100 v, which circulates 100 amp full-load current through the load, taken as a resistance of 1 ohm.

The load current, in flowing through the rotating armature conductors, creates a stationary armature flux because the armature conductors on the left of the brush axis always carry current in the same direction and the armature conductors on the right of the brush axis always carry current in the opposite direction. The combined effect is the same as that of a stationary solenoid, producing flux as shown in the left and right flux loops. This armature flux is of about the same magnitude as the excitation flux but it is not doing any useful work.

Two questions arise: Can this idle

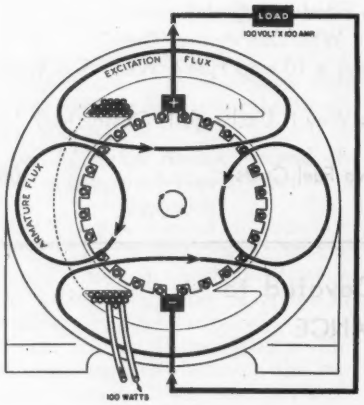


Fig. 1

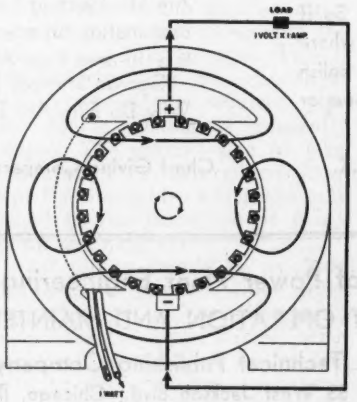


Fig. 2

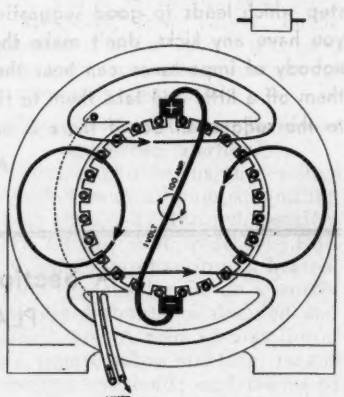


Fig. 3

armature flux be utilized? Can the excitation power, now too large for accurate control devices, be reduced to a point where small, fast response devices can be used, and yet release the same full output?

With a smaller field coil, and with excitation power reduced from 100 w to 1 w, the same conventional generator appears as in Fig. 2. The new reduced excitation power creates only 1 per cent of the original excitation flux. Voltage at the brushes is reduced from 100 v to 1 v, and the load current, also reduced from 100 amp to 1 amp, produces only 1 per cent of the former armature flux.

Thus, one objective has been attained —excitation power has been reduced to a value where it can be readily supplied and handled by precise control devices.

How can we restore full-load working flux and yet retain this low excitation power? A SHORT CIRCUIT across the brushes, as in Fig. 3, restores the armature current and consequently the armature flux to their full original values. This is because the internal resistance of the armature winding is assumed to be 1/100 of the load circuit resistance. The load has been disconnected. The excitation power and flux continue to be extremely small, but they now control the full-sized armature flux.

But the armature flux is still idle. Can we "harness" it, and put the armature back to work delivering full kilowatt output?

To put the short circuit to work, two new brushes are added, as in Fig. 4, one in the center of each armature flux loop, just as the conventional brushes are located in the center of the excitation flux. Let us assume for a moment that these new brushes are not connected to any load and that we are only measuring the voltage between them. We had assumed in Fig. 1 that the armature flux was of about the same magnitude as the full excitation flux in the same figure. The armature flux being full value produces full voltage, 100 v, between the new brushes. We now connect these new brushes to the same load—one brush directly, the other through a compensating field shown on the south pole. 100 amp, full current, circulates through the load. In the same armature conductors, the new load current adds to and subtracts from the short circuit current. This is shown by the four different combinations of "dots" and "tails" now seen on the armature conductors.

Note, however, that the new load current in the armature conductors cannot set up its own armature flux which would be directed from right to left because any tendency in this direction is neutralized by a compensating field of equal and, as shown by the "dots" and "tails," of opposite strength. The output of 10,000 w is released by an excitation power of 1 w. This is an Amplidyne.

The Amplidyne goes "ALL OUT"! Assume that the excitation current is suddenly doubled (an increase from 1 w to 4), (Fig. 5). This instantly doubles

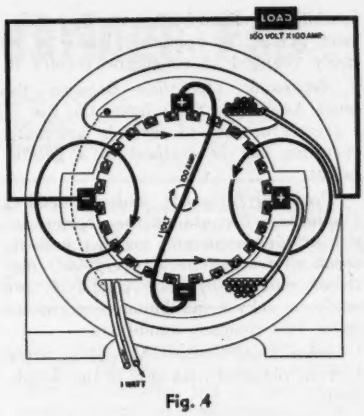


Fig. 4

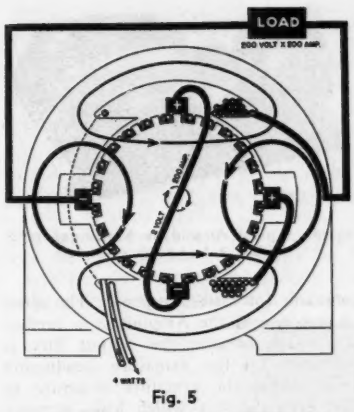
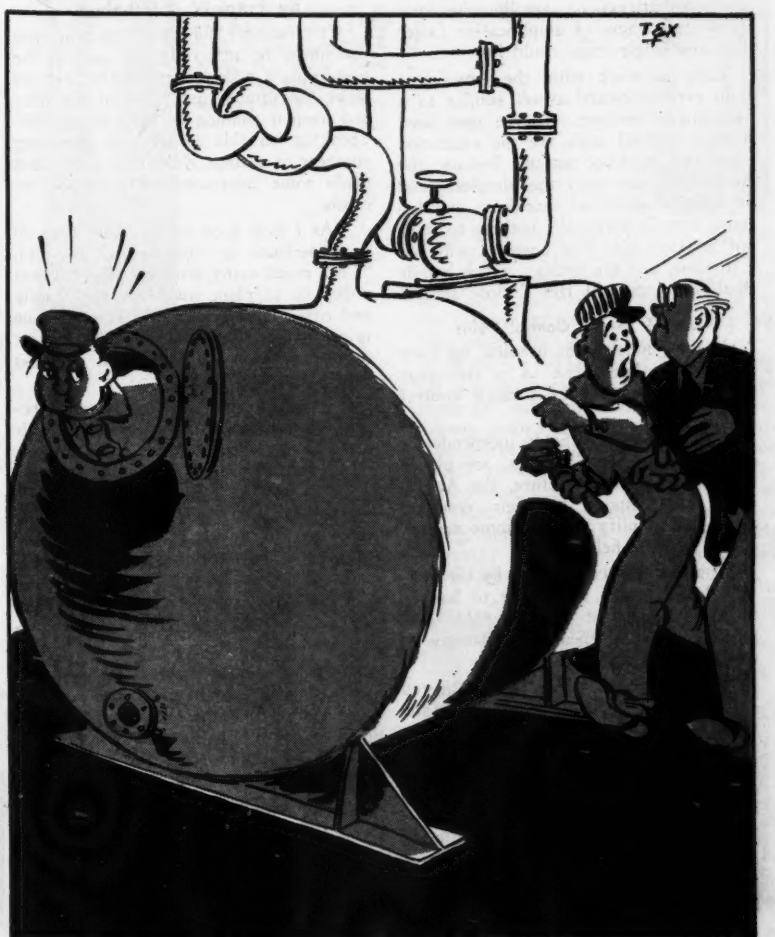


Fig. 5

the short-circuit current, producing double output voltage (200 v) and forcing double current (200 amp) through the load. Thus, by merely raising the control input by 3 w, output is raised from 10 kw to 40. To obtain comparable changes in output in response to minute changes of excitation with conventional generators would require two generators—a small control signal would excite the first one; the output of the first generator would excite the second. The output of this second generator would considerably amplify the small control signal to the first one but with a cumulated delay in response.

In the Amplidyne, the equivalent of a full-size exciter (utilizing the same armature structure and conductors) is available to forcibly excite the output



"He didn't have any trouble getting inside to make the repairs but he had to eat his lunch in there"

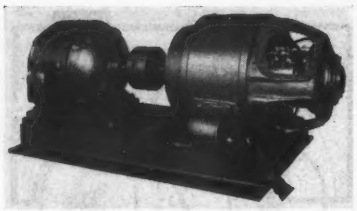


Fig. 6. Typical Amplidyne Motor-generator Set, 3 kw, 1750 rpm

generator for fastest response. The speed of response of the Amplidyne is further accelerated because the output flux is produced by the armature conductors from within the armature structure so that even the flux which leaks through the air produces useful voltage.

The symbol shown in the heading graphically represents the Amplidyne as two full-sized generators "compressed" into one. The minute control field and the short-circuited circle are identified with the first stage. The compensating field and the other circle connected to the load are identified with the second stage.

The Amplidyne provides an entirely new combination of amplification and speed—two stages of amplification faster than any single stage could be.

Easy to work with, the Amplidyne is in every outward aspect similar to a conventional exciter. All the user need concern himself with are the excitation input and working output. Because the Amplidyne uses only the simplest laws of rotating electrical machines, and because there is practically nothing to wear out, it stays put. The bearings will last a lifetime, and the brushes which handle small currents will run a close second.

Use of Several Control Fields

In the symbol in the heading, we have shown the Amplidyne as a two-stage amplifier responding to a single control field.

If several control fields, independently excited from signal devices, are placed on the same pole structure, the Amplidyne will respond to their resultant action and amplify it in the same manner as for a single field.

The small space required by the individual coil makes it possible to have a normal complement of four fields permitting many independent functions to control the Amplidyne output.

Each of these fields is easily adjusted by a small resistor or other means, and since their current requirements are so small, their action may be automatically blocked by small rectifiers as long as a certain operating condition or limit is not reached.

Simplicity—This use of multiple fields in the Amplidyne greatly reduces the number and size of control devices required to obtain a certain performance.

Ease of Adjustment—Because they are so small, these fields are easily adjusted within a much wider range than conventional fields. Considerable flexibility is thus built into the equipment permitting operating limits to be easily changed if conditions require it.

Automatic Operation—Because the small Amplidyne fields invite the use of a greater number of controls, automatic operation can be realized to a greater extent.

Peak Performance under Transient Conditions—Because of the forcing action of the Amplidyne, together with its practically instantaneous response, machines excited by the Amplidyne are made to deliver maximum performance under fast changing conditions.

High Amplification—As high as 10,000 to 1—is obtained *with ease* in the Amplidyne.

Reliability—Since all these desirable characteristics are built into the system, they become in fact a part of it; and the Amplidyne will keep on delivering these characteristics year after year, giving unfailing performance.

It May Be Hard to Get but Have You Tried the Plant Itself?

By Frank V. Faulhaber

THE PRESENT difficulty of getting new equipment or materials for use in the power plant makes it necessary that we make the utmost use of what we have and keep it running as long as possible. Speaking on this subject, an operating engineer of a large New York City plant made some interesting observations recently.

"As I look back on my more than 30 yr experience in engineering," he said, "I can recall many instances where it was policy to supplant machines too readily and often later regretted. This practice is continued even today. This is a most opportune time to halt such reckless purchasing.

"In many plants there is great reluctance to make any attempt to repair slightly worn equipment; it is thought to involve too much time and work.

"Whatever justification there may have been for such practices in the past they certainly have no place in any plant today. Furthermore, I question whether it is ever sound practice to buy new equipment when with a little effort a machine can be repaired from a plant's own stocks.

"Many establishments have on hand discarded equipment parts and supplies of various kinds, the real value of which is often overlooked. Why not tap this wealth of material? Make a list of it and if possible augment the supply by adding such parts as still are available."

Recounting a specific instance, the engineer continued, "In one plant the chief engineer had some of his staff go through his old standbys and auxiliary equipment. Many things were found that could serve admirably in an emergency, particularly an old boiler that required just a good overhauling and a few new tubes. These were quickly installed and now this veteran boiler is again functioning like the hearty old-timer it is! No need for a new boiler here!

"An old pump was found that a neighboring plant was only too glad to snap up, without quibble, though it required the addition of a few new parts to fit it for service.

"It was decided by the management of that plant to otherwise dispose of to all-around advantage whatever of its extra equipment it could spare. Some nearby establishments could use nicely a couple of engine compressors that again came to light, and a concern right out of town took fancy to a somewhat out-dated hoisting apparatus — never mind its obsolescence; it is playing its noble part, very efficiently, all in the interest of National Defense!

"Among a power plant's stored machinery and equipment," observed the engineer, "can be found many serviceable pieces that thus could be placed to good purpose. If a given machine or operating unit is of no use to the plant itself, it would be well to sell it to another establishment much in need of it, and mighty glad to get it! Most managements, as I have already indicated, are unaware of their real possessions along this line, particularly when it is just routinary custom to store away a plant's old, unused and surplus machines and materials, and when nothing concrete is being done to capitalize to the utmost on these stocks.

"And so long as the management continues to do nothing about it, the entire organization will be none the wiser and none the richer. I know there will be some to contend it is unprofitable to probe the potentialities of such stored materials. They will assert it takes up too much time. Such contention will hold little water. What of the valuable time persistently being consumed searching for new machinery and materials, involving additional monetary outlay, and the consumption of time and effort installing new operating units, of which the plant may be uncertain, and, moreover, oftentimes requiring considerable experimentation until things again start to run smoothly? Yes, admitting that things finally will run smoothly.

"It is erroneous to say that such a course is unprofitable. No matter how undermanned a staff, there will always be occasions when a man is free with some extra time that well might be utilized by assorting the plant's stored materials. You will find piping, fittings, valves, and many odd and sundry things that can be used again. A little re-working, re-tightening; a little repacking, here and there, and another unit is renewed, ready for service. The same thing holds for stuffing-boxes, piston rods which sometimes simply need a little boring or turning when badly worn. Too many of the small things are too readily cast aside in favor of the handy new, when all that would be needed would be a little timely and competent attention."

Why Ball Bearings Fail

By C. A. COMSTOCK
Chief Inspector
The Fafnir Bearing Co.

Only a fraction of 1 per cent of the bearings in service fail prematurely—AND nearly all of these can be prevented by moderate care on the part of the user. The "Whys and Wherefores" of typical bearing failures are reviewed, pointers given as to how they might have been prevented and suggestions as to how unsatisfactory conditions can be detected and corrected. It's up to you, Mr. Bearing User—to keep your bearings in good condition

SIMPLY to furnish a starting point for an analysis of bearing failures, it should be recognized that from 80 to 90 per cent of all ball bearing defects in service are attributable to causes beyond the control of the bearing manufacturer, in other words, purely and simply the fault of the user. A conscientious scrutiny of the record makes any other interpretation impossible.

This being the case, it develops upon ball bearing makers in general to better acquaint all users with the do's and don'ts of bearing care and maintenance—particularly in the current period of near-shortages and vital need for high production, but it might be interesting first to see just what can happen to a bearing when service fundamentals are disregarded.

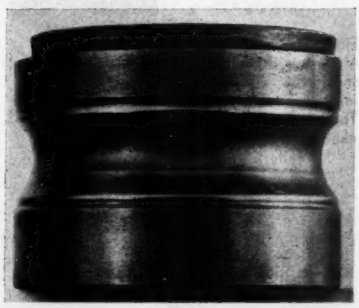


Fig. 1. Grooves on the shoulders of this ball bearing inner ring were worn by the retainer which dropped down when dirt, acting as an abrasive, reduced the size of the balls

Some of the more common causes of failure are dirt and abrasives, faulty lubrication, misalinement, improper mounting, and overload.

Dirt

Of these the greatest is Dirt—Public Enemy No. 1 in the life of a ball bearing. Any foreign matter other than the proper lubricant is to be construed as dirt, incidentally, and it may gain entrance during assembly, repairs, from the atmosphere, or even as adulterants in the lubricant itself.

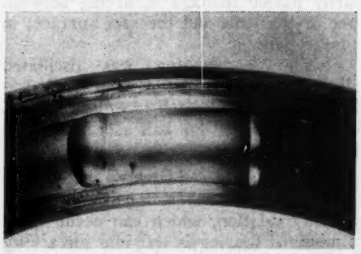


Fig. 2. An excessive amount of dirt eventually stopped the balls from rotating, and transverse vibration wore these indentations in this ring

A not-too-untypical analysis, for example, of the material which got into one bearing while in service shows particles of metal grit, sand, sawdust, graphite, and even a short length of soft wire. This heterogeneous mixture acted as an effective grinding compound. It set up a lapping action between the bearing races and balls, which injured the raceway finish and also caused the internal clearance of the bearing to be greatly exaggerated. This resulted in a too-loose fit, and diminished both bearing life and capacity.

With lapping down of the balls, on which the retainer was supported, the latter dropped against the rings, and, again aided by the abrasive, wore grooves in the race shoulders, as shown by Fig. 1. When the retainer subsequently broke, the space between the rings became so filled with chips and abrasive material that the balls were prevented from rotating. Since the inner ring was locked to the shaft it accordingly had to slide on the balls. Obviously, no bearing can last long under such conditions.

Fig. 3. Misalinement in this bearing caused the balls to run eccentrically in this outer race. Cramping caused overloading and early failure

Fig. 4. When the balls run eccentrically, flaky spots soon appear on one race or the other and accelerate failure. Sometimes, however, the retainer is the first part to fail in a misalined bearing

Fig. 5. The non-uniform width of the ball path in this outer ring indicates an out-of-round housing. (There is also some misalinement.) Out-of-round shafting will produce the same effect on the inner ring

With the balls locked in a bearing of this kind vibration will sometimes cause the ball complement to move transversely, with the result that deep indentations will be made in the outer race as shown by Fig. 2. With conditions reversed—i.e., the outer ring rotating and the inner stationary—similar indentations would appear on the inner race. Such vibration failure is sometimes termed friction oxidation or false brinelling.

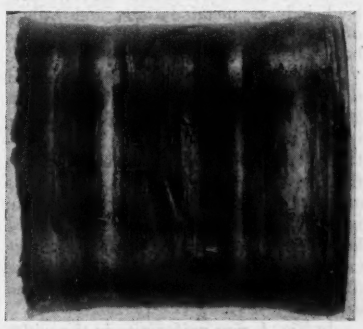


Fig. 6. This section of the inner ring of a double row bearing shows what can happen under severe overloads. The condition of some of the balls taken from this same bearing are shown by Fig. 7

Misalinement

Misalinement has always been a predominating cause for bearing failure for it results in extreme overloading. In one case the bearing mounted in a housing was out of line with the shaft. As a natural result the balls ran eccentrically over the outer race as clearly shown by Fig. 3. At the high points of eccentricity this meant the balls were cramped between the races, thus overloading the bearing.

In addition to this, the shaft was undersize and the inner ring of the bearing tilted on the shaft. The balls, therefore, had to run over the inner race in the same eccentric manner as on the outer ring, thereby further cramping the bearing.

Fig. 7. What a bearing is sometimes called upon to take is shown by the condition of these balls, taken from an overloaded bearing

With faulty mounting of this kind, either the inner or outer race soon developed a large spalled or flaked spot, as shown by Fig. 4. When the balls pass over the metal particles thrown off there, deep impressions are made in both the inner and outer races. Failure would have occurred in this bearing even though the inner ring had not subsequently cracked as a result of the stresses set up by concentration of the load through the misalinement.

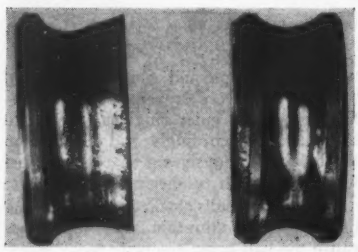


Fig. 8. Excessive thrust on a bearing not designed for this purpose caused this failure and complete wearing down of one side of the ring

A bearing operating under such a condition is usually overloaded, as we have seen, due to the fact that the balls are cramped between the races; this overload induces metal fatigue and failure of the bearing through spalling of the balls and races.

In a number of cases of this type of misalinement, however, failure is brought about by breakdown of the retainer rather than metal fatigue. As the retainer runs eccentric, variations between the speed of the balls at the high points and low points of the races results in jamming them in the ball pockets. This heavy strain combined with the wear causes it shortly to break, with collapse of the bearing itself following soon after.

In Fig. 5, non-uniformity in the width of the ball path in the outer ring clearly indicates a housing which was out-of-round and undersize at the small diameters.

Where the ball track widens, the housing had pinched the ring, again causing undue concentration of load (or overloading) and leading to early failure. This would have happened even though misalinement had not been present to contribute to it. Oversize, out-of-round shafting would produce the same result on the inner ring.

Simple overloading also plays its part in bearing mishaps. This is usually evidenced first by intermittent spalling in the races (as the fatigue limit of the steel is exceeded) after which general breakdown follows rapidly. An extreme case is the double row bearing shown by Fig. 6 which shows what can happen under the worst conditions.

Heat developed by the severe overload also softened the inner ring to the point where the raceway shoulders were literally rolled down to almost nothing under the two-way reversing thrust. The ring itself spread a full inch laterally. What happened to the balls meanwhile is also clear from Fig. 7.

Sometimes overload conditions are caused not so much by extreme load as by imposition of the wrong kind of load, for instance, a pure thrust bearing asked to carry heavy radial load, or vice versa. The duplex bearing illustrated by Fig. 8 is a case in point. It can absorb normal thrust loading readily enough, but not the amount it was suddenly made to carry in this application.

Not unnaturally the result was another bearing tragedy. The balls in the right half of the duplex pair (against which the excessive thrust was first exerted) were forced so far out of their proper track as to wear down the inside shoulder and even part of the left-hand member of the pair. Mounting the pair in a tandem arrangement (specifically designed for thrust) instead of back-to-back, would have permitted the two halves to act as a unit in resisting thrust and could have alleviated much of the difficulty.

Fig. 9. Bearing trouble is often caused by improper lubrication. On this double row bearing grease forced into one side never reached the other

Lubrication

Lack of lubrication is one of the more common causes of failure. Too much lubricant is very detrimental to successful operation, of course, but some is essential. Figure 9 is typical of a double row bearing where grease was forced into one side but never reached the other.

The retainer on the unlubricated side was discolored from the heat developed, and badly worn in the ball pockets. Balls and races on the same side were also discolored, indented, and even had particles of the disintegrating retainer welded to them. On the lubricated side all elements were still in good condition.

For the bearing maker's own part, if ceaseless vigilance in manufacturing operations is relaxed even slightly, a defective product may result. For example, in the bearing shown in Fig. 10, failure was brought on from inattention to details in the grinding process.

Fig. 10. Inner ring etched with acid to show the effect of improper machining. The hard areas and checks soon cause failure

By etching the inner ring with acid, grinding checks and "superhard" areas become visible. The former caused by taking too big a cut, the latter from the heat generated by a glazed wheel. Both lead to flaking and chipping of the metal in the raceways and eventual failure.

A more unusual failure is that caused by electrical action. The bearing in Fig. 11 was enclosed in a housing, and mounted on a shaft. Though idle at the time, the bearing was under vibration, when an electrical current momentarily passed through it, arcing between one of the balls and the race surfaces in contact with it.

Since the bearing was oscillated slightly, by the vibration, a deep zig-zag line was etched on each race, Fig. 11, and on two sides of one ball as can be seen in Fig. 12.

Rust and Grease

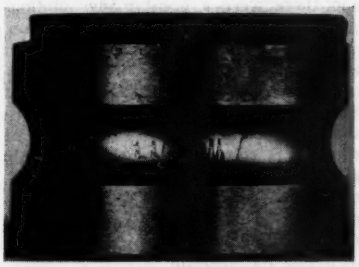
Another cause for bearing failure is grease oxidation, which can occur when a mounted bearing is left idle for a long period of time. During the idle period a chemical change in the grease—known as oxidation—will take place in some lubricants, releasing corrosive acids which

stain and etch the races and balls of the bearings.

The flawless finish being destroyed, pitting and flaking ensue and failure is not far off. Entrance of water or moisture into the bearing proper will result in rust deposits and similar, though more pronounced, stains (see Fig. 13) with the same ultimate result.

From this catalog of bearing deficiencies, it might appear that ball bearings are far from the near-perfect mechanical parts they are commonly thought to be. Yet it must be remembered that all the bearings failing prematurely constitute but a small fraction of 1 per cent of

Fig. 11. The deep etched lines on these bearings were caused by an electrical current arcing across. The bearings were not rotating at the time but there was sufficient vibration to cause the zig-zags



the total in service, also a close look will reveal that nearly all these troubles could have been prevented by the exercise of only moderate care on the part of the user.

As such, bearings failing to attain their full useful life represent an economic waste chargeable in large part to you, Mr. Bearing User!

If replacements are sometimes difficult to obtain promptly, isn't it then the part of wisdom to take preventive measures in your plant to see that time-consuming breakdowns and shutdowns from bearing failures are held to an absolute minimum?

Fig. 12. Etched marks on one of the balls taken from the same bearing as the races shown in Fig. 11

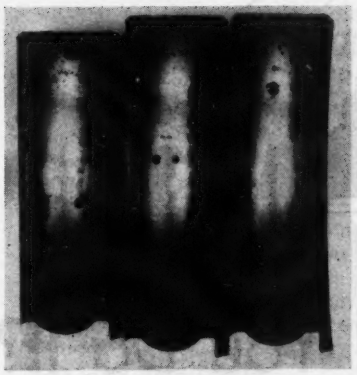


Fig. 13. Stains and rust deposits on races resulting from the entrance of moisture. Less pronounced corrosion may also be caused by lubricants after long idle periods

Data on Belt Loadings

IN LINE with the country's rubber conservation program, The B. F. Goodrich Co. has released data on a series of tests on transmission belting and V-belts conducted under the supervision of George H. Stewart, belting engineer. These tests proved that the life of these belts is greatly influenced by the tension factor and that an increase in the tension over that recommended for the belt operation will result in failure of the belt long before it should break down.

Three types of present wartime construction of transmission belting were used in the tests, which were run at 15 lb. per in. per ply, a total of 720 lb. for the tension, which is the recommended figure, and at 18 lb. per in. per ply, a total of 864 lb. tension, on 4 in. pulleys. The belts were 6 in. wide, 30 ft. long and spliced in 10 ft. endless lengths. Tests were all highly accelerated.

Belt No. 1 ran for 95 hr. before breakdown under the 18 lb. tension and increased its life to 230 hr. before failure when the 15 lb. tension was used. Belt No. 2 ran for 88 hr. at the 18 lb. tension and for 263 hr. before failure at 15 lb. Belt No. 3 ran for 15 hr. under 18 lb. tension and its life increased to 48 hr. under the 15 lb. tension.

Conclusions reached are that an increase of 3 lb. per in. per ply over the recommended tension results in the belt giving only approximately one-third of its useful service life.

Similar conclusions were drawn from tests conducted on one style of V-belt which is used on a popular make washer. The accelerated test consisted of a dead load suspension with the driver sheave 2⅝ in. outside diam. by ½ in. top by 36 deg. and the driven sheave of 5¼ in. outside diam. by ½ in. top by 40 deg. First three belts under tension of 125 lb. center to center averaged 4½ hr. of life before failure. The second three, under 95 lb. tension centers, averaged 27.4 hr., while the last three, under 80 lb. averaged 86 hr.

The company points out that because of the short, highly accelerated nature of these tests, they are not to be considered an index to life in actual service. They were made only to get data on the ratio of tension to belt life. To be of real service, tests should be made for much longer periods.

Oil to Coal Conversion

By S. H. CHAPMAN
Stoker Department
Westinghouse Electric & Mfg. Co.

ONE OF THE FIRST questions that arises when it becomes necessary to convert a boiler from the use of oil fuel to coal is, will the conversion reduce the capacity of the installaton? While the answer to this question depends upon the particular conditions surrounding any installation, on most applications an underfeed stoker meets the requirements with minor furnace changes. A few bricks and a small amount of concrete and the conversion is complete. Stokers, however, should be selected with care. The surest way to judge the fuel burning qualities of a stoker is to see it operate and obtain the opinion of the operators. By all means, even in these busy times, visit an installation of the make and type of stoker you propose to buy before you buy it.

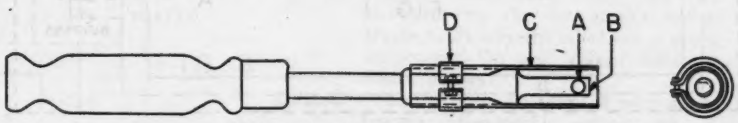
As to comparative fuel costs, these can easily be obtained by means of the chart presented on page 100 of this issue. This chart gives the fuel costs per 1,000 lb of steam for both oil and coal.

Simplifies Small Wire Soldering

THE JOB of soldering small wire connections is simplified at General Electric by making the iron stationary and dipping the connections into a small hole filled with solder near the tip of the iron.

As shown by the drawing, the soldering iron can be fixed for use in this manner by drilling a hole (A) into the tip (B). A nickel steel tip will last longer than other types.

The drip and splash guard (C) catches surplus or drips of solder coming off the iron. It is made of 1/32-in. steel and is fastened to the iron with a hose clamp (D).



Soldering iron for wire connections

How Would You Do It?

PROBLEM 28. OUR HERO RUNS INTO A WIRING PROBLEM

CURSES on Our Hero and his buddy Bachmann from Schenectady. If they have to think up wiring problems like that in Schenectady, why don't they keep them there? With the General Electric Co. right in the back yard, there ought to be enough electrical experts around loose so they would not have to bother the rest of the country with them. If Bachmann had taken his problem to the boys in the back room at Nickalaus's Cafe any weekday night instead of getting Our Hero all het up about it, he could have had his answer over a stein of ale, and we, and our Board of Judges, not to mention the many poor readers who wasted hours on it, would all have been better off for it.

What in Heaven's name does anybody want to hook up four buzzers in such a screwy manner for anyway? As one of our esteemed contestants put it, why don't they just open a window and holler? That is what our Board of Judges finally did—until the cops arrived on the scene.

They (the B of J) are in a fine pickle. Everything was serene at first. A few letters came in and the judges merely put them in their dockets (whatever they are) and continued their normal comatose existence. Even when the letters began to pour in by the dozen, still nothing alarming occurred. One day, however, one of the members of the board, feeling unusually spry and somewhat curious, began to look through the letters and after a few minutes let out a whoop. "Caveat emptor, e pluribus unum, corpus delicti," he shouted in his best legal manner. "What have we here? These bloomin' answers are all alike."

In an instant all was commotion. The judges and the diagrams were all over the place at once, all mixed up. Sure enough, all the diagrams were alike. There were the four buzzers, and the four sets of push buttons and the signal lights, all hooked up by means of the 3-wire cable. There were a few variations; some contestants had used a red pencil instead of black, and some were on tracing cloth, others drawn on the backs of menus, the latter confounding the judges no end because they only looked at the menus; but the diagrams were pretty much all alike. In general, they fell into two groups, one group meeting the requirements of the problem with only the equipment specified and

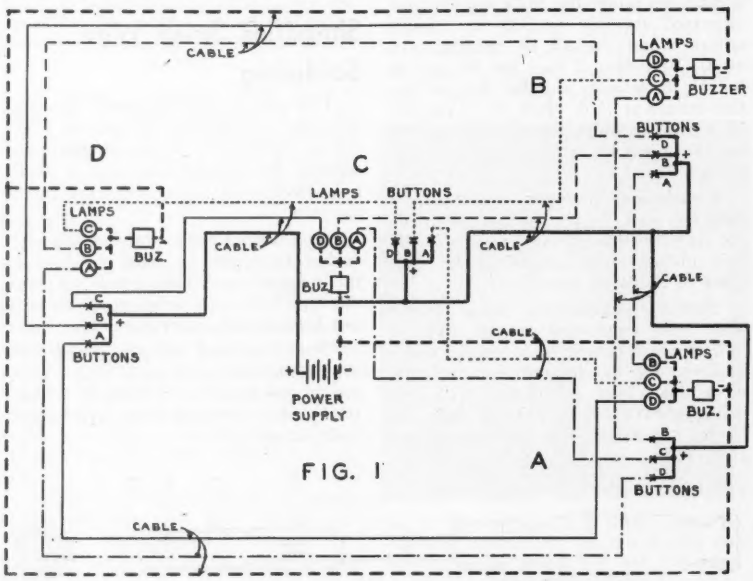


Fig. 1

another group which solved the problem by the use of additional relays. These relays caused a lot of hot argument; some of the judges, the reactionaries, wanted to discard the solutions using relays at once and started to throw them out of the window. This move was violently opposed by the liberals who insisted that the use of relays was perfectly valid, that they improved the circuit and if Bachmann and his Hero pal didn't have sense enough to put them in, well, what of it?

In the end, the reactionaries had their way, the relays were not admitted despite the fact that they provide a much better system. The system can be hooked up without the use of relays but as pointed out by many of the contestants operation will not be satisfactory. The trouble arises from the fact that the buzzer and the signal lamps have to be connected in series. If the voltage is high enough to light the lamp when the buzzer operates, the lamp is liable to burn out when the contacts of the buzzer happen to stick closed. Furthermore, without the use of relays, the signal lamps remain lighted only while the push buttons are pressed. This means that if the push button was pressed only for a short time, the person answering it would still not know which station was calling.

Even though the judges decided not to admit the solutions using relays except where they were offered as a second solution, their troubles were by no means over; they still had to award the prizes and there were a great many solutions which had the correct wiring diagram. As usual, however, they managed to find a loophole. The awards, it may be recalled, were to be awarded for the best solution consisting of a diagram and a short explanation. Since a number of contestants solved the problem correctly as far as the diagram was concerned, the awards were made on the best explanation of the various factors involved in the practical solution of the problem including the diagram.

On this basis, the first prize was awarded to Mr. Nichols of Reading, Mass. There was never any doubt about this; for once, all the judges agreed. Mr. Nichols not only solved the problem by the conventional method, that is without the use of relays but in addition submitted a solution using relays. More than that, in his explanation he discusses all the various factors that should be considered in hooking up the system. His remarks in regard to the influence of the "make-and-break" type of buzzer are much to the point and his suggestion of using a clock type of a-c buzzer is an excellent one. Mr. Nichols' diagrams, as presented here, are his own—we present them exactly as he submitted them with no re-drawing or changes of any kind.

The award of the second prize to our friend Moore of Wilmington, Del., was not so easy and it involved some hot discussion by the members of the Board of Judges. The Chief Justice contended that Mr. Moore's letter was ribald and vulgar, that it insulted the dignity of the court. Furthermore, he questioned

brother Moore's veracity in relating the incident about the automatic elevator in Weehawken. The Judge said they didn't have elevators in Weehawken. The Chief Justice was overruled, however; after all, Moore's solution was correct for he presented both the relay and the non-relay wiring diagrams and despite his lack of respect for the dignity of the court he seems to know something about the operation of buzzers and signal lights. So the second prize went to brother Moore.

Ralph Jones and R. Hoeneisen were tied for third place so a duplicate third prize was awarded to Mr. Hoeneisen. Both of their solutions were excellent; they submitted both the relay and the non-relay methods and their analyses show a thorough understanding of the factors involved.

The prize winning letters follow:

FIRST PRIZE AWARD

Prescott R. Nichols
Electrical Engineer, Municipal Light Dept.
Reading, Mass.

I am enclosing diagram marked Fig. 1 which shows connections for Problem No. 28.

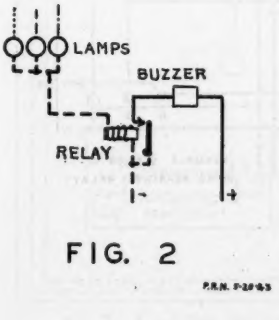
There are, however, quite a number of points that should be considered in order that the system may operate satisfactorily. It will be noted that in all cases the buzzer is in series with a lamp which means that both buzzer and lamp must be of the proper resistance or impedance and the applied voltage must also be suitable. If the voltage is high enough to light the lamp when the buzzer operates, the lamp is liable to burn out if the contacts of the buzzer happen to stick closed.

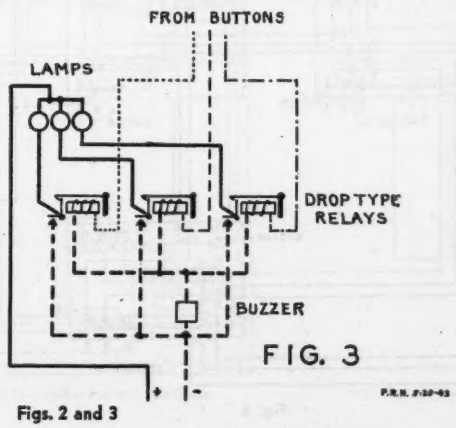
It would be advisable to use a toy transformer having adjustable voltages, such as is used for toy trains, as a power supply and the voltage could then be adjusted until the system worked. A type of buzzer similar to that used in electric alarm clocks, which consists of a vibrating member operated by the 60 cycle current and having no contacts, would be an improvement since there would be no danger of burning out the lamps as the resistance would always be the same.

Another method of overcoming this trouble would be to substitute an a-c relay for the buzzer, the relay contacts closing an auxiliary circuit to operate the buzzer as shown in Fig. 2.

If a more elaborate system is desired, a relay of the telephone drop type could be installed in place of each lamp and the contacts connected to an auxiliary circuit to operate the light as in Fig. 3. With this system the lamp would remain lighted after the receipt of the signal, until the relay was manually reset. This could also be wired so that the buzzer would operate continuously which, however, might be a disadvantage.

In conclusion, I would urge the use of the adjustable transformer, since due to the cable limitations, the circuits are considerably extended, and the clock type of buzzer if it can be obtained. If this latter cannot be had, by all means use an a-c relay and auxiliary circuit for the buzzer. I also repeat that the transformer, lamps and buzzer or relay must match and if this is done the system will work.





Figs. 2 and 3

SECOND PRIZE AWARD

L. P. Moore
Wilmington, Delaware

Our Hero was right the first time. Problem 28 is quite simple. It must be simple because the prizes total only half what was passed out last month to a bunch of mere steam garglers. A guy by the name of Merrill got top nod. Why, he didn't leave enough Btu over to warm up the watchman's coffee. Maybe that's why you called him a young steilacoom! Oh well, fifteen dollars is fifteen dollars!

But back to Problem 28 with all its buzzers, unreasonable tenants, etc. A

Problem 29
ELIMINATING MOISTURE FROM A PAINT SPRAY COMPRESSED AIR LINE

OUR Hero has a sort of a paint job on his hands this month. At the plant where he holds forth they have just installed a new lacquer and varnish spraying equipment which uses compressed air at 180 psi at the rate of about 30 cfm. Our Hero has nothing to do with the painting but he supplies the air from the compressors installed in the engine room. The varnish department has raised a howl; they say that Our Hero's compressed air is full of moisture and that it spoils the work. This is probably true since no particular effort is made to remove moisture and as far as the other uses to which the air is put is concerned, a little moisture makes no particular difference. There has never been any complaint about it from other departments.

So it is Our Hero's problem to install some sort of device or equipment to remove the moisture. In ordinary times this would probably be relatively simple; he could go out and buy what he needed. With conditions as they are however and since this varnishing operation is not of strategic importance, it is up to him to devise something which he can make himself. He has thought of several ways to solve the problem but before he goes ahead he would like to see what others would do if they were in his shoes.

How would you do it? What sort of gadgets would you suggest for removing the moisture and how would you make them? Send us your ideas in a letter of not over 1500 words and show by means of sketches how the equipment would be designed. Extremely detailed designs are not necessary but simple drawings with a few approximate dimensions will be given credit in making the awards.

The compressed air system used is a conventional one, consisting of two compressors with inter and after coolers and two receivers located just outside the engine room. The receivers are located about 500 ft away from the varnish spray equipment, the latter being supplied through an overhead air line.

Send us your solutions by July 31. A $25.00 war bond will be awarded for the best solution. A second prize of $10.00 will be awarded for the second best solution and a third prize of $5.00 for the third best. Entries in this contest should be marked Problem 29 and should be addressed to the Contest Editor, Technical Publishing Co., 53 W. Jackson Blvd., Chicago, Ill.

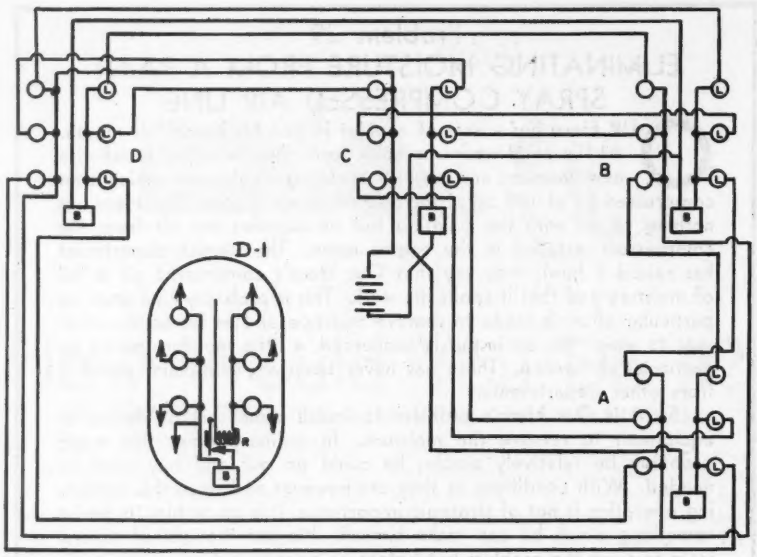


Fig. 4

curbstone contractor would probably do the job with half those wires. Here (Fig. 4) is the wiring diagram to help Carl Bachmann hook up his junk. Personally I would throw most of it away and put in a tel-e-talk system—or just open the window and holler.

Theoretically this circuit should work, but confidentially it—well it isn't worth a darn. Even after correctly balancing the resistances and wattages of the signal lamps and buzzers, you would have trouble with burning buzzer contacts, flickering signal lights and general all round cussedness.

Just think what would happen if two buttons were pushed at the same time! Remember that automatic elevator at Weehawken, N. J.? Two guys pushed buttons at the same instant and that elevator went sideways three miles out route 39! Imagine the lifted eyebrows if that sort of thing should happen in Schenectady—of all places!

Beside all the above, your neighborhood radio fans would curse your duodenum, jejunum, and illium, with consuming and justified fury.

May I suggest that Our Hero go out and buy himself four small relays, to go into the system as shown in sketch at "D-1". Oherwise he better get a new tenant, or just skip the whole business and go join the WAAC. Ain't life getting just *too* complicated?

THIRD PRIZE AWARD

Ralph L. Jones
Muskogee, Okla.

In Fig. 5 you will find my suggestions for Problem 28. According to this plan each station will be able to know by their respective signal bulbs illuminated and buzzer ringing just which station is calling.

For an example: If Station "A" wishes to contact Station "D", Station "A" will just push the bell button marked "D" and the results will be that the signal bulb at Station "D" marked "A" will illuminate, and at the same time the buzzer at Station "D" will vibrate.

This same result will be seen in the operation of any bell button calling any of the three remaining stations. The only thing I can see that is impracticable in regard to this plan is the fact that it will be necessary to hold the button down at least 4 or 5 sec before the filament in the signal bulb will get hot enough to throw off the necessary light, depending on the current drain of the buzzer as compared to that of the signal bulb or vice-versa, and this information I didn't have.

Suggestion No. 2 is that sensitive relays could be used if the tenant was agreeable for the extra expense. This would give positive operation of lights and buzzer, and inasmuch as these relays could be placed at each respective station, it wouldn't require extra cable, therefore no additional expense as to tearing up floors or walls would be involved, and the labor cost would be low, as any electrician could install this relay in a half hour or less.

DUPLICATE THIRD PRIZE AWARD

R. Hoeneisen
Wilkinsburg, Pa.

In Fig. 6 you will find a diagram of connections giving a solution to problem 28. The four Stations A, B, C, and D have been interconnected using the three-wire conductor without armor as explained in your memorandum.

The system will work as follows:

If, for instance, the operator of Station A wants to call Station B, he will press the bell button marked B of his Station. In closing this bell button, circuit will be completed through the buzzer of Station B, which will operate. In Station B, to identify the call, in series with this circuit there is an electromagnet corresponding to the signal bulb marked A, which, being energized, will complete circuit of bulb, lighting it. This will indicate to operator of Station B that Station A is calling.

Similar circuits will be completed from any Station to the other three.

As in the data given in your problem,

SUGGESTION NO. 1

SUGGESTION NO. 2

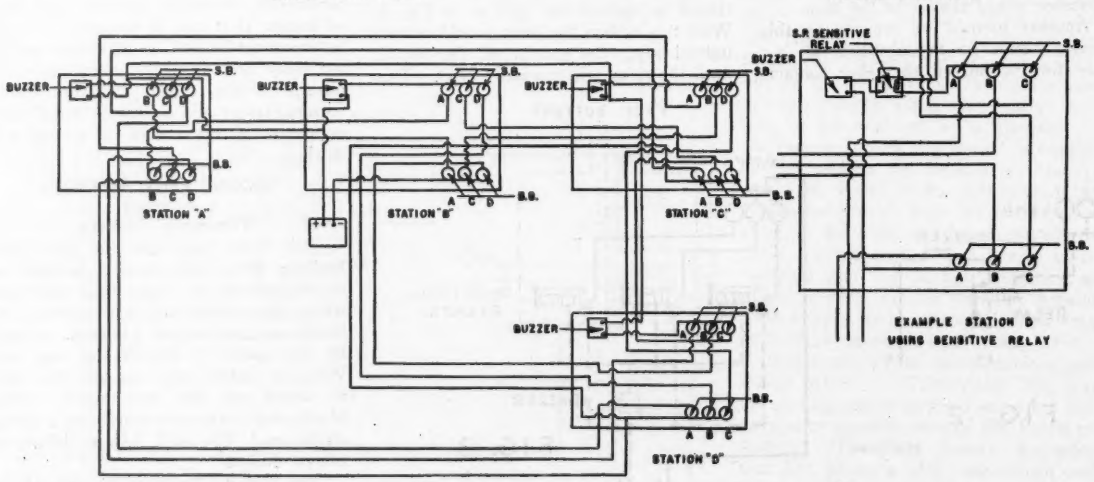


Fig. 5

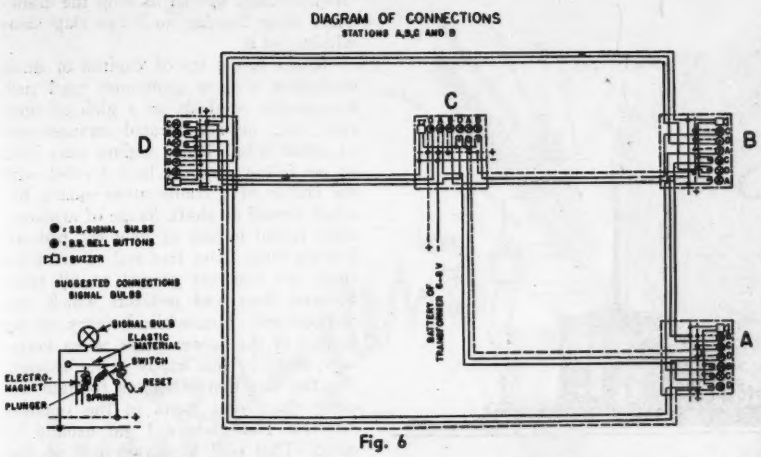


Fig. 6

no special reference is made to a certain type of signal bulb used, I chose a type which diagram of connections could be as sketched on the bottom left of the general diagram of connections of the system.

After a call, the operator of the Receiving Station must reset the switch of the signal bulb in order to have the corresponding circuit ready for another operation.

If full voltage on the buzzer is necessary, once the electromagnet of the signal bulb has been energized, it would be easy to add a switch in parallel with the electromagnet which would short circuit it under the movement of its plunger. This would avoid unnecessary current flowing through the coil after the corresponding signal bulb has been lighted.

Comments on other solutions

As already mentioned, there were a considerable number of contestants who submitted the correct wiring diagram but who did not discuss all the factors of the problem in the same degree of completeness as did the prize winners. Among those submitting the correct wiring diagram are the following:

Gunnar Spillum, San Francisco, Cal.; Fred E. Gould, Dalton, Mass.; E. J. Amole, Norristown, Pa.; Wayne G. Shaffer, Waterford, Conn.; G. C. Scott, Chicago, Ill.; L. G. Wainman, El Paso, Tex.; W. A. Dynes, Jackson, Mich.; Julian P. Calvert, Flushing, N. Y.; Calvin H. Hood, Northampton, Mass.; Garland Fieser, Champaign, Ill.; Leslie Erven, Danville, Ill.; W. R. Lowe, Syracuse, N. Y.; Walter G. Anderson, Chicago, Ill.; E. L. Musolf, Duluth, Minn.; D. C. Attridge, Long Beach, Cal.; M. M. Lowry, Little Rock, Ark.; Matt G. Tometz, Minneapolis, Minn.; J. K. Jacobson, Milwaukee, Wis.; A. Ekberg, Iron Mountain Mich.; and Gustav Isakson, Chicago, Ill.

Some contestants introduced variations into the problem which went beyond the limits of the problem but which are nevertheless of interest. One such is the solution sent in by Thos. W. Benson. His diagram is shown in Fig. 7. Mr. Benson assumed that double-contact push buttons could be used. Quoting from his letter, "the upper contact being normally closed to the signal device which is connected to one side of the power supply. The lower contact is open and connected to the other power lead. It is evident that pressing either button will signal the other station." The use of these double-contact push buttons is interesting but as is evident from the other solutions, they are not necessary.

A few of the contestants went so far as to try out their ideas to see whether they would work. D. C. Attridge, for example, said he tried putting a buzzer and light in series and it worked. He used a No. 15, size 1 Edwards Lungen buzzer and No. 1 Mazda, PR6, 2.5-v lamps on a 6-v battery.

The difficulty of operating the buzzers in series with the signal lamps was evident to many. M. M. Lowry, for example, pointed this out and suggested that for the successful operation of the system, high frequency type buzzers should be used.

On the use of relays

Of interest was the considerable number of solutions incorporating the use of relays. Relays were not specified in the statement and therefore these solutions could not be considered in awarding the prizes but the fact remains that the system is improved considerably by the use of relays.

Among those solving the problem by the employment of relays are the following:

Miss Lucy Miskofsky, Saskatoon, Saskatchewan, Canada; L. J. Cuthbertson, Girard, Kan.; G. F. Suchy, West Fargo, N. D.; B. R. Stocks, Omaha, Neb.; M. A. Young Steilacoom, Wash.; Fred Meyer, Bogota, N. J.; John B. Merkle, Colgate, Md., and Geo. Malloy, Petosky, Mich.

A typical diagram of the relay method of solution is the one submitted by Miss Lucy Miskofsky of Saskatoon, shown in Fig. 8. The current relay which operates the local circuit for the buzzer is only energized when the push button closes the circuit and consequently the light and buzzer will operate only when the button is pushed. Miss Miskofsky points out that a special relay could be used which would cause the local circuit (including lights and bell) to remain energized until reset. This certainly would improve the system.

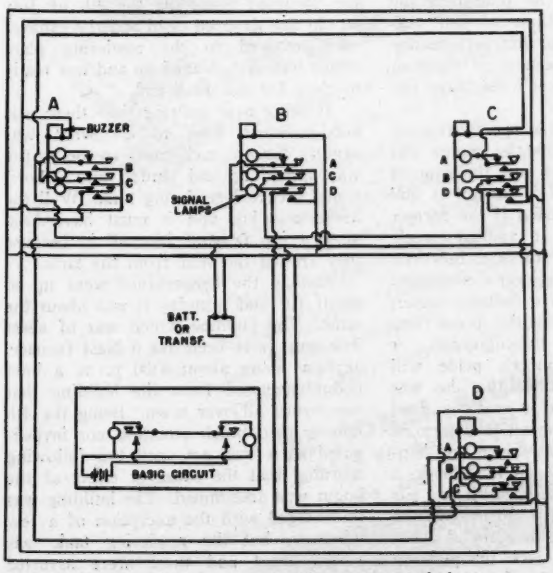


Fig. 7. A solution using double contact push buttons

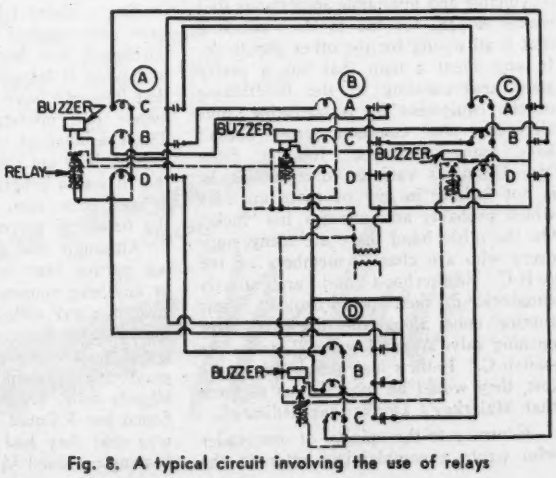


Fig. 8. A typical circuit involving the use of relays

LETTERS AND COMMENTS

From Malarkey's College of Practical Knowledge

MALARKEY'S DON'TS having inspired some comments from P.P.E. readers, maybe the author should take a bow or two and also enter a few very profound observations.

I must admit that upon first noting "Pro & Con" in the February issue that I immediately and without further reading concluded that some presumptious buffoon had had the effrontery to impugn the authority of Malarkey's say-so. By the time I found opportunity to peruse carefully Mr. Holman's comments I had mentally composed a masterpiece of rebuttal and invective, which of course I had to lay away in the mental mothballs as I found that Mr. Holman's idea and experiences were almost identical with my own.

I think that in the 20 yr I have been around power plants, I have broken every rule in the book and got away with it (not counting, of course, the times I got fired). Anyhow at the time of writing I still have all the accessories, appendages, and appurtenances with which I was born. Like Mr. Holman I had full realization of the chances I was taking when I took them, but figured that the results to be obtained were worth the risk involved. Safety seems to be one of those indefinable and intangible somethings that makes it OK for me to do something that is all wrong for the other guy to do. In any event a man that has a pretty good understanding of the functioning of the equipment he is operating, plus alertness, plus common sense, doesn't have many accidents. Judging from Mr. Holman's various contributions he is not lacking in any of these qualities which probably accounts for his "luck." On the other hand there are many engineers who are charter members of the A-B-C Brotherhood and are strictly ritualistic in their performance. Their routine runs along the line of "after opening valve A, crack valve B, and close switch C." If their instruction sheet were lost, they would be too. It was to them that Malarkey's Don'ts was dedicated.

Contrary to the opinion of one reader who wrote a complaining letter to the editor several months (or more) ago and managed to wheedle a somewhat doubtful tribute to the operating engineer from (I believe) Mr. Iddles of the B & W Company, I maintan that in the majority of cases the continuous and uninterrupted operation of power plant equipment is a measure of the engineering skill and knowledge of the manufacturer and not of the operator. The equipment runs in spite of, not because of, the operator's efforts.

Recently the illustrious institution of learning of which I am the very lowest of faculty members (Naval Training School instructors are soon acquainted with the difference between their status and that of the Regulars) purchased second hand two three-cylinder vertical uniflow engines which the school engineer set up. After one week's operation the crankshaft of the larger unit (200 kw) broke. The smaller unit (150 kw) was then set up and placed in service but I knew that unless something was done this machine would go the same way, but what the hell could I do about it?

Suggestions, usually, are pooh-poohed with the inference that interdepartmental interference will not be tolerated, and that the school traditions of self sufficiency, smuggery, and job perpetuation must be retained regardless of right or wrong, and besides doesn't the Navy pay 60 per cent of the bill?

The engineer felt that the shaft must have been cracked when the engine was purchased, that he was just unfortunate in having it let go after he got it and that it would have broken if the former owner had operated it another week. The character of the fracture, however, did not bear out the engineer's contention that it was a progressive failure; rather, it was quite clear that the break was the result of extreme misalignment.

Although the engineer's pride will not permit him to admit that he was in any way remiss, he is really a good sort of a guy and is trying to determine the cause of the trouble. Since this happened I have prevailed on him to do a good job of relining-up which he has already done. He will not tell me what he found but I found out in a round about way that they had to jack the pedestal bearing up about ¼ inch. Zounds!! The chief has also agreed to strip the crankshaft some Sunday so I can slap some whiting on it.

In the lining up of engines or other equipment I have sometimes used sueh unorthodox methods as a glob of mercury, etc., and complicated arrangements of plumb-bobs. These engines were lined up as follows, engine base leveled with the bubble of a combination square, flywheel forced on shaft, flange of armature shaft bolted to hub of flywheel, pedestal bearing hung from free end of armature shaft and concrete poured to fill space between floor and pedestal which was unsupported. Meanwhile I carry on my classes in the power plant when necessary, more or less happy in the thought that the direction of engine rotation will carry the flying parts in the opposite direction from where I am usually located. That is, I hope they will go that way although I suppose the Navy boys should get acquainted with shrapnel and projectiles early in their Navy career.

Now if this engineer had read and followed the ideas given in an article written by a guy named MacDermod entitled "Checking Up On Old Engines" and published about a year ago in the P. E. & E. section maybe this wouldn't have happened.

One of the simpler enjoyable features of life is the snickers one gets from various occurrences, provided the snickers are not at some one else's expense. I snickered when I read Mr. C. T. Baker's article in the April issue with regard to food decomposition as it recalled an amusing incident that occurred several years ago when I was a resident inspector of boilers in that swell town of Lynchburg, Va.

At that time Lynchburg enjoyed the prestige of having the only rendering plant for miles around. The plant of course was located at a respectful distance from the business and residential sections and made proper disposal of the various livestock whose demise was due to old age, over work, tiredness, etc. On the Saturday preceding the 4th of July an old nag dropped dead and the cadaver was removed to the rendering plant which had just cleaned up and was ready to close for the week end.

It being near quitting time there was not sufficient time to do what was usually done in such cases so the corpse was hacked up and stuffed into a horizontal jacketed rendering tank. Well the horse was big and it must have been quite a job to stuff him all in because they stuffed the vent from the tank.

Sunday the temperature went up to about 107 and Monday it was about the same. The building which was of sheet iron must have been like a blast furnace, anyhow along about 4:00 p. m. a loud boom emanated from the building that was heard all over town. Being the 4th nobody paid much attention nor investigated so it was not until the following morning that the cause or effect of the boom was determined. The building was undamaged with the exception of a few windows, but the rendering tank was blown apart and there were assorted horse's parts everywhere.

. . . is o.k. for savages

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Lacking other evidence it was concluded that packing the horse in the way they had had obstructed the openings and vent and decomposition had generated sufficient gas to cause an eruption.

All in all I don't know which was the worse, subjecting my olfactory organs to the aroma of decayed horse which seemed to cling to my person for a long time thereafter, or the odor from that well advertised soap that I used in an effort to rid myself of that social affliction that the soap supposedly should take proper care of. 'Tis indeed fortunate that at that time I was not married.

MALARKEY

This Started It*

FOR SOME time I have been having an argument with myself, should I, or should I not, renew my subscription to your fine paper, POWER PLANT ENGINEERING. I finally decided in favor of renewing, but why I confess I do not know. What I would like to know is, why does anyone want to be an operating engineer, with all the responsibility, grease and soot thrown in? One has but to look around to see other men who do not know a thing about engineering earning three to four times as much as you are and all they know is how to cut a thread on a pipe. They call themselves steamfitters. Other fellows who could do little more than wire a door bell call themselves electricians, and they also receive big money.

I have spent my entire life in engine rooms, boiler houses and machine shops. I have stayed home nights and studied, trying to make myself a better man for the boss but I have come to the point where I believe I would have been better off if I had gone out and enjoyed life instead of spending my time studying.

I have always dreamed of the day when I would be at the top and could say to myself, "well done, it has been worth the effort." To date, however, I have not got my foot off the first rung of the ladder. I have met a number of fellow engineers who had made the top but after trying to talk shop with them I wondered how they got there. In some cases I discovered they had married the Old Man's daughter or had been taken out of another department and put in charge of "power" so as not to cause any friction with the rest of the operating force.

We all know that some men are born to be leaders and also that some men learn faster than others; also some have what is known in the vernacular as an extra amount of guts, but at the same time opportunity should be provided for those who do a good job and try to better themselves by study and diligent application. A man who does his job and studies should be paid for his effort, not given the old "run-around" about having a steady job, a warm place to work and where he can sit down while the factory help have to hit the ball from whistle to whistle.

The fellow who wrote, "to earn more, learn more" should have written, "to earn more, complain more." I have just quit a job as chief engineer of a large industrial power plant after 23 years service, where in 1933 I installed and rebuilt a used 400 kw engine-generator set. I spent 3 yr talking to the boss and showing him figures before I could get him sold on the idea. I do not believe I would have sold him then except for the fact that he was holding stock in the power company and when it failed and the value of his stock was way down, he finally consented, I think more for spite than on the strength of my figures. And after 3 yr of operation with only one shut-down and that one for only 2 hr, he told me that from their figures in the office, the steam plant was saving the company $13,500 a year over the previous arrangement.

Though he had never said, "thanks, you and the boys have done a good job," I thought on the strength of what he had told me I might get a raise. When I approached him on that subject, however, he told me the mill was just able to break even the last 3 yr and he could not see how he could possibly pay me more money. But he bought new cars and farms whenever he wanted them.

Now, Mr. Editor, I would like you to tell me just what use is it for an engineer to spend time trying to do a good job, trying to teach the men under him, answering their questions, encouraging them to buy books and stay home nights to study when all you can see ahead for them is long hours, dirty work and their efforts not appreciated. We all like to believe that the engineer should stand just as high in the world as men in other skilled trades or professions but to my way of thinking, his position is about on a level with that of a street cleaner. Why is it that the engineering societies do not care for membership of operating engineers? They cater to the professional engineers, but who corrects those guys' mistakes? The operating engineer! No, Mr. Editor, I don't believe the game is worth the effort. I like engineering, I love the sound of steam and the working of a steam engine, but I think I will satisfy God's urge by getting a toy steam engine and running it whenever I feel like it. Thanking you for all favors shown me in the past, I am,

Yours for victory,

WM. F. HEIWIG

Seymour, Ind.

*This was the letter that induced me to write "Pass the Ammunition" in the January issue. Ed.

Priorities Lead to Water-Cooled Valve

THE STORY by Harold S. Sykes (p. 88, December, 1942 issue) on how he operates a steam pump on compressed air brings to my mind an experience which was also due to priorities. I needed more compressed air than I could get from my three air compressors, so I began to shop for a used compressor. I finally got an old compressor, hooked it up and ran it for 4 days.

In the 4 days, we burned up the discharge valve and the disc in the special check valve, a type I use on the others. Reducing the speed of the machine did little good.

Finally as a last resort, I took off the head, which, by the way, is above the water jacket. Taking a sheet of galvanized metal, I cut out a metal gasket in the middle of the sheet to coincide with the cylinder and bolt holes. Using the metal gasket as bottom, I proceeded to make a metal box.

After the box was done and corners soldered, I put a regular gasket on the head and then one on the cylinder. Then, placing the box on the bolts and then putting the head on, I bolted her up tight. When all was done, the cylinder head, discharge and suction valves and part of the discharge piping were inside the box.

Then, filling the box with water, we started up the machine and it has run satisfactorily ever since. The box was also fitted with a valve for filling and a drain.

Baltimore, Md. CHAS. W. PARKS

It's in His Blood

AFTER READING your article entitled "Born That Way" in the April issue of P.P.E., I would like to add a few comments. To begin with, my Dad is an engineer and a mighty good one. Ever since I can remember I have been around boiler and engine rooms. I practically cut my teeth on a scoop and it had the inevitable result. To me there is nothing so beautiful as a smooth running engine. I love to get into a power plant and smell the various aromas that go with every power plant. Naturally, I am doing some mighty hard study in the field and at present I hold a Mass. 1st Class Fireman's License and regardless of the fact that I am in the Army, I am determined that I am going to get my 3rd Class Eng. License in the near future.

When I first came in the Army it made me feel mighty blue to think that I would be away from steam plants for the duration. However, the gods were kind to me and I am now firing in the Army. As much as I would like to, I am unable to give details for obvious reasons but let it suffice to say that I am still a fireman.

A few weeks ago, when I was home on a furlough, my first in seven months, I got no end of thrills in going to the plant where Dad is operating and running the plant myself under his guidance. It sure felt great to be in a large plant again.

I was much pleased to read Mr. Mullen's article on what was being done to train operators. I have been in the habit of visiting various plants in my spare time and I have learned plenty by doing so.

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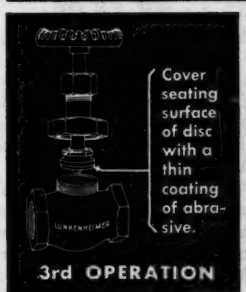
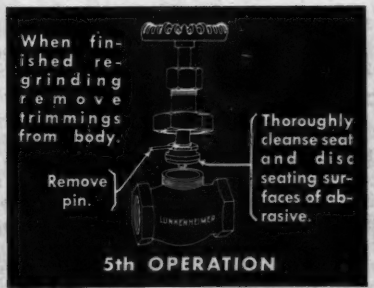


Replace trimmings in body and regrind.
Extension on bottom of hub should enter neck of body while regrinding.
Allow union ring to remain loose
4th OPERATION


When finished regrinding remove trimmings from body.
Remove pin.
Thoroughly cleanse seat and disc seating surfaces of abrasive.
5th OPERATION

BRONZE, IRON, STEEL AND CORROSION RESISTANT ALLOY VALVES, 125 TO 2500 LB. S.P.; BOILER MOUNTINGS, LUBRICATING DEVICES, AIRCRAFT FITTINGS

Questions And Answers

Question No. 231

Who Has a Work Schedule For a 6-day Week?

Do YOU have in your files or records a work schedule covering a 6-day week, either rotating or non-rotating? All the schedules appearing in previous issues of POWER PLANT ENGINEERING are for 5-day or 7-day weeks.

Detroit, Mich. R. J. K.

Editor's Note—In reply to the above, we had to tell R. J. K. that unfortunately we could not find a 6-day week schedule in our files. Readers of Q. & A. will doubtless remember that in the August, 1939, issue of P. E. & E., a reader asked about work schedules. In reply, about 40 readers sent in copies of their schedules. A number of these were published as follows: Sept., 1939, page 611, 7-day schedule; Oct., 1939, page 676, 5-day schedule; Nov., 1939, page 736, 5-day schedule; April, 1940, page 79, 7-day schedule. Many others, duplicating those published, were sent along directly to the man who asked the question but our records do not show that any of these were for a 6-day week.

Recently a rotary slide rule device, the Shift-O-Graph, for setting up work schedules on a basis of total hours of work per week, by two different plans, has been issued by, Geo. S. May Co., Business Engineers, 2600 N. Shore Ave., Chicago, and 122 E. 42nd St., New York City. Inasmuch as wages are now paid in so many cases on an hourly rather than a daily basis, this seems a very logical basis for figuring work schedules. This device might enable R. J. K. to work out the one he needs.

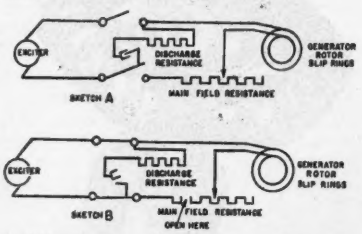
In any case, if any reader has a schedule for the 6-day week all worked out, we'll appreciate it if he'll make it available to R. J. K.

Question No. 232

How Much Inductive Kick Current Will He Get?

1. WHAT CURRENT will flow from a generator rotor as "inductive kick" current if 250 amp is flowing just before the normal generator field circuit is opened instantly and the rotor discharges through a known value of discharge resistance? A typical circuit of this kind is shown in Sketch A.

This question is prompted by my attempt to order an arrester to install in parallel with a discharge resistance. The salesman for the arrester manufacturer says they have no arrester for such service or above 25 amp normal current flow in the coil. Lightning arresters are not what they list for this service but a similar one. General Electric Co. Bulletin GEA-1962 on CR 9196 Thyrite discharge resistors lists only 1.5 and 7.5 amp circuit sizes. I am not in a position to get reliable data on the characteristics of the circuits involved. The manufacturer claims they do not make arresters for protecting rotors. The salesman had the idea that for the service described I would need a device with greater current-carrying capacity than a regular arrester. Should I drop the idea?



J. W.'s diagram of typical generator rotor circuit. Sketch A shows normal circuit just after field switch is opened. Sketch B shows circuit with field switch closed, unit carrying load and main field resistance burned open

2. What would the inductive kick current be if the main field resistance burned open as shown in Sketch B, with the unit in operation and the field switch closed?

Akron, Ohio J. W.

Editor's Note—To arrive at a numerical value of the "inductive kick" current, you will, of course, have to assume values of discharge resistance, main field resistance and generator rotor inductance. J. W. says he cannot determine these. However, the important thing is to show him the method of figuring it. Since he asked the above question, he has written us again as follows:

"In the meantime I have had a little experience with using a condenser across a magnetic separator coil, energized by selenium rectifiers. An indicating lamp was connected, right at the coil, in parallel with it. This lamp, a carbon type, burned out each time the coil circuit was opened, in spite of a discharge resistance across the switch in the control cubicle 200 ft away. A voltmeter showed a 120-v 'kick' but when I connected a condenser at the lamp I only got a 20-v 'kick' and with the condenser installed, no more lamps burned out. Placing the condenser at the resistance 200 ft away was useless. The wires to the discharge resistance are two No. 12 in. BX."

Calculations of inductive current in such circuits is none too easy and very little has been written on such situations as outlined above. Of course, a more satisfactory way would be to connect an oscillograph to the circuits and actually plot the transients as they are produced.

This whole question of inductive kick current may have some bearing also on the Question No. 220, What Makes the Marks on the Collector Rings?, page 106, May issue.

Answer No. 203

This Engine Pulls Water Out of the Boiler

EVERYBODY who commented on this problem in the March issue seemed to feel that the engine needed some attention to the valves. You remember that in the December issue, E. H. asked what he could do about his 16 by 15-in. 257-rpm Uniflow that "pulls water out of the boiler" when load is put on.

Now, however, Paul Hunt calls attention to the fact that nobody has yet discussed the problem of carryover from the boiler.

How About Carryover from the Boiler?

I NOTE in the March, 1943, issue that one of the readers is having some difficulty due to carryover when operating a 60-kw generator with a Uniflow engine. I do not believe any of the answers given will correct the carryover; however, they will aid in reducing steam consumption.

The following will give relief to the operator having the troubles:

1. Check with the boiler manufacturer on the correct water level to carry in the boiler even though you believe it now to be correct. Many times the level is too high and will cause carryover at high boiler loads.

2. Check alkalinity of boiler water to be sure boiler is free of excessive scale and that total solids are not excessive. An extremely high OH alkalinity by the BaCl test will give trouble. Various boiler manufacturers allow different total solids without carryover; however, at high ratings 2500 to 3000 ppm can very safely be carried. If the boiler in question is an Hrt boiler and is only operated at 150 per cent of rating, 4000 to 4500 ppm can be carried if the blowdown is to be excessively high.

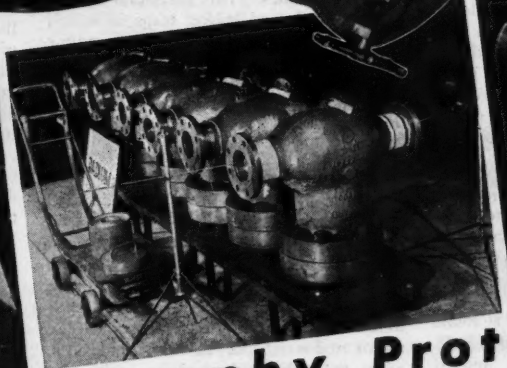
3. A suitable steam separator should be installed ahead of the engine. If a separator cannot be purchased, the attached sketch shows how to make one that will adequately dry up the steam and eliminate all water entering the engine with the steam.

4. Install a steam trap on the exhaust steam line from the engine, provided the engine exhausts to a closed system. The trap must be of a special design to operate on pulsating pressure.

5. Be sure the engine operates on a constant steam back pressure, which should be as low as possible.

6. By all means check the engine over and have the valve gear properly set and rings fitted for a minimum blow-by.

Edward 12 in. 1500 lb cast steel stop valve with impactor handwheel shows gamma ray negatives completely encircling welding ends. Body markings indicate locations of negatives during radiographic examination of other areas. Unique radium capsule fixtures of original Edward design facilitate production inspection.



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RADIOGRAPHIC EXAMINATION is a standard inspection procedure for Edward cast steel valves.

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The lessons they have learned are reflected in advanced foundry techniques, and progressively better valve design.

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EDWARD
Steel CAST AND FORGED
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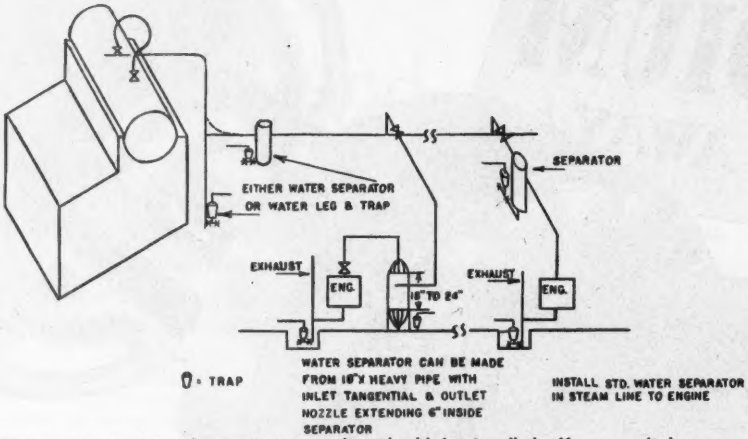


How water separator for engine steam line should be installed. If you can't buy one, make one as shown. Use correct traps for pulsations on exhaust lines

7. Check steam cylinder lubrication and be sure oil is of good grade and adequately used.

8. Be sure all steam lines and engine are properly insulated to reduce condensation.

If the above is followed, I'm sure the operator will have little difficulty operating his engine with the present boiler.

Port Neches, Tex. PAUL N. HUNT

Are His Heating Lines Filled with Scale?

EDWARD SMITH, JR., in the January issue, described a 50-yr.-old building heating system, low gravity return type that he says fails to heat the building properly, although supplied with 15 lb. steam from one of two new 50-hp. boilers. He asked if this trouble might be caused by scale in the system and, if so, what to do about it.

Rust Rather Than Scale May Cause Trouble

FROM MY EXPERIENCE with the operation of such systems, as a rule the water from a boiler rarely gets into the system, although I would want to have more information as to just exactly whether this is a hot water or a steam or vapor system. Operating at 15 lb. pressure would suggest steam, and if steam is used I cannot see how the boiler water could get into it or through the radiators.

Consequently I do not see how the radiators could contain scale from the water; but I can very readily see how, due to neglect and the lack of any effort to treat the water for the prevention of corrosion from he steam returns, there might be a great deal of tuberculation or rusting throughout the entire system.

This is a common type of trouble in steam and vapor systems, unless something is done to take the gases out of the water so that they will not condense in the steam, and fairly thick or heavy layer of porous rust could impair very greatly the heating efficiency of such a system. And insofar as removal is concerned, I would not want to venture an opinion, because after rust does exist, its removal would very greatly weaken and impair the strength of the system itself, though it unquestionably would improve its efficiency; but such removal would have to be, I believe, mechanical rather than chemical.

Winnetka, Ill. DUDLEY K. FRENCH

Baker Reports Scale Trouble in Such Systems

HERE is the result of my past experience with a similar layout. I was running an old so-called heating plant in a place once and the system wouldn't ever get warm. I found that most of the trouble was accumulations of scale and other dirt at the valves and fittings in the various lines. This particular system also had a lot of bucket traps in it and some of these I had a devil of a time to get open and cleaned out they were so full up with scale, grease and dirt of all sorts.

Buffalo, N. Y. ROBERT BAKER

Answer No. 216

Examination Questions: Who Can Answer Them?

EXAMINATION QUESTION 2. List the materials you would expect to find on the job if you were sent out to it to install a 250-hp., 4000-v. wound rotor induction motor. The service into the motor room is 13.2 kv. and enters the room through rigid conduits which are threaded.

Ans.—

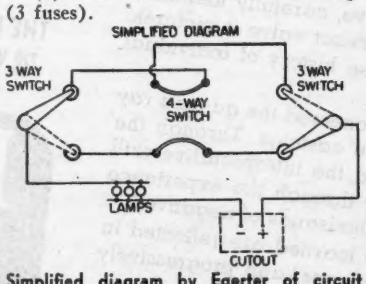
(1) A transformer, ratio 3.3-1.

(2) Rigid conduit.

(3) Coils of cable, No. 6, stranded.

(4) Junction box for connecting motor leads.

(5) One cutout fused for 50 amp. (3 fuses).



Simplified diagram by Egerter of circuit required in Question 3A.

(6) A switch box with magnetic controllers.

(7) Greenfield for making flexible connections to junction box.

(8) One solid piece of ground wire, No. 6, for making connection to a water pipe.

(9) Lugs and pipe clamps.

EXAMINATION QUESTION 3. In the following layout, L represents a bank of lamps and S the stations from which these lamps may be turned "on" or "off" regardless of the position of any other switch.

A. Give the wiring diagram for this job.

B. Write out a requisition for the switches. Ans.—2 three-way switches, 1 double or 4-way switch.

Tullahoma, Tenn. CARL EGERTER

EDITOR'S NOTE — *A diagram showing these same connections and an identical requisition came in also from Gordon S. Relphsnyder of Morgantown, W. Va.*

Answer No. 217

Is a 10-amp Fuse Always a 10-amp Fuse? Well—See Watt George Started!!!

FRED HARTMANN asked, in the April issue, "What is the difference in carrying capacity in amperes between a 10-amp, 250-v fuse and a 10-amp, 500-v fuse? Would both blow at the same amperage at either voltage and is the difference in length the only reason for the different voltage rating?"

In his reply to Mr. Hartmann, published with the question, Andy Kramer pointed out that there is no essential difference in the carrying capacity and that the voltage rating applied only to the voltage of the arc that the fuse can effectively interrupt.

George Deichmann, however, in his comment in the May issue, said he didn't agree and proceeded to prove that they wouldn't blow the same way and that the voltage had a lot to do with the carrying capacity.

Well, we said, "Go it, wife! Go it, b'ar!" And did they go! Look what George has brought down upon his head.

Ohm's Law Is No Good Here

MAY I VOICE a protest on the publication of letters of the type signed by George Deichmann in your department in the May issue? His reasoning is obviously so incorrect as to require no comment but since you insist on further discussion, I'll risk an answer. (Editor's Note—We, too, believe he was wrong but he has a right to his say and we wanted to bring out just such correct ideas as yours.)

A fuse, any fuse, is not a power consuming device and any attempt to apply Ohm's law leads nowhere. A fuse is a current-limiting device and is concerned only with the current (amperes) flowing in the circuit it is intended to protect. Since there is practically no voltage drop across a good fuse, it follows that the voltage of the circuit does not enter into the consideration of the current that will blow the fuse.

TIPS ON VALVE TRIM
TO HELP KEEP PIPING ON THE JOB
How to Repair Valves
Short-Cuts to Faster Piping Jobs
FOR SPECIFIERS
FOR PIPEFITTERS
HELPFUL HINTS ON CHOOSING VALVES FOR BETTER PIPING SERVICE

Ask for as many sets as you need. Requests filled as received while supply lasts.

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What to do when a tee can't be had—a globe valve—or a needed reducer? How to get jobs completed despite materials shortages? How to help themselves in emergencies is what today's piping maintenance men must learn if vital production lines are to be kept flowing.

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ARMY E NAVY

CRANE VALVES

However, when a fuse does blow, the reverse condition arises; there is no current through the fuse but full voltage is applied across the terminals. Thus the fuse must be designed for the voltage of the circuit it is used in, to provide proper quenching of the arc formed on blowing and ample insulation against breakdown when full voltage comes across the terminals. So we have fuses rated for use on different voltages but this has no bearing on the current that will blow them.

(Editor's Note—This is exactly what Kramer said in the April issue but George wouldn't believe him.)

I wonder if Mr. Deichmann is aware that he has been using 250-v fuses on his 110-v lighting circuits for a long time with good results or that he will have no difficulty blowing a 500-v, 5-amp fuse on a fresh dry cell.

Philadelphia, Pa. THOS. W. BENSON

The Army Marches into the Fray

THOUGH I now find myself in the Armed Services, I still enjoy reading your magazine and get a lot of valuable information from it. I would like to put my oar into this little discussion that seems to have been touched off by the question, "Is a 10-amp fuse always a 10-amp fuse?"

Our friend, George Deichmann, says, "No!" in the May issue and submits some figures to prove it. His figures are correct in themselves but he is trying to prove the wrong thing.

Let us look at the reason for the existence of a fuse. A fuse is used to prevent excessive current flow and, as such, is rated in amperes, unit of current flow. The voltage rating, found on most fuses, is put there to prevent operators from inserting fuses into lines of higher voltages than the insulation of the fuse can stand. Remember that when a fuse blows, we get the full line voltage across the terminals of the fuse and if these terminals are placed too close together the fuse will arc over. That is the reason for the voltage rating.

A fuse is rated so that when a current flows through it greater than the rated current, the heat generated in the fuse element, due to the resistance of the element, will cause the element to melt and thus open the circuit. Now, while VOLTS $\times$ AMPERES = WATTS, and watts may be considered to be a measure of heat, the voltage we must use in this equation to find the heat necessary to melt the fuse element is the voltage across the fuse terminals, at a current just great enough to burn out the fuse, and not the line voltage. Incidentally, the voltage across the fuse terminals would be very low.

The point where George made an error is that the fuse is not across the line and does not have line voltage impressed on it until the fuse burns out, at which time, assuming a single-fuse circuit, it would have full line voltage impressed across the terminals.

I still say that a 10-amp fuse is a 10-amp fuse.

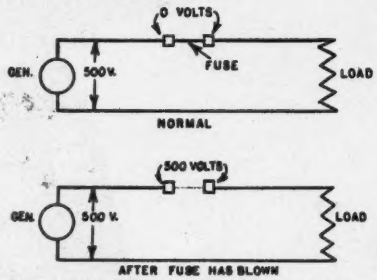
Camp Davis, N. C. ALBERT W. JORDAN
Capt., U. S. Army

He Disagrees Emphatically

I DISAGREE emphatically with George Deichmann's answer to Question 217 in the May issue. The only thing right in what he wrote was that you should use fuses as labeled.

A 10-amp fuse will blow at 10-amp regardless of the voltage. The voltage rating is for a safety precaution only and does not have anything to do with the current at which the fuse will blow.

If a 10-amp, 220-v fuse were used on a 500-v line and blew at 10-amp, there would then be 500 v between the ends of the fuse and an arc might continue to hold after the fuse was blown. But if a 500-v, 10-amp fuse were used, the distance between the ends of the fuse would be too great for an arc to form.



Jerry Halstead's diagram showing how the line voltage is not applied across the fuse until the latter has blown

Mr. Deichmann also states that a 500-v, 10-amp fuse shows that it is good for 5000 watts. His mistake here is in assuming that the 500-v is across the fuse, when actually it is across the load and the voltage across the fuse is practically 0 until it is blown. This shows why a 250-v fuse would be dangerous only after it was blown.

Pittsfield, Mass. JERRY HALSTEAD

It's Not Watt George Said It Was

I CERTAINLY do not agree with Mr. Deichmann in regard to the difference between a 10-amp, 250-v and a 10-amp, 500-v fuse. Anyway, 500-v fuses are not made; the next voltage rating above 250 is 600.

The difference between these fuses is in the length, because a longer fuse is required to interrupt an 800-v line without danger of an arc forming from one end of the fuse to the other when the fuse blows.

What makes a fuse blow?

It is certainly not $10 \times 250 = 2500$ watts, for that would indicate that the whole line load was being dissipated in the fuse as heat, which would be at the rate of 8530 Btu per hr.

What causes a fuse to blow is the heat liberated in the fuse, which in watts is the current squared times the resistance of the fuse. The line voltage has nothing to do with causing it to blow. It could be 10 v or 10,000 v.

Whenever current flows in a conductor, some of the energy is converted into heat, and always follows the I^2R law.

The heat in a cartridge fuse is conducted from the fuse strip to the end ferrules and to the fuse clips and is dissipated to the atmosphere.

Therefore, any fuse carrying a steady current will reach a temperature where the heat is dissipated at the same rate as it is liberated in the fuse.

Now if the current is doubled, the amount of heat to be radiated will be increased four times, or if it increases three times there will be nine times as much heat to get rid of. The only way the same fuse can radiate more heat is for its temperature to rise, which is what happens until the melting point is reached—then the fuse blows.

Any fuse used in corroded or poorly fitting fuse clips will not carry its rated load because the extra heat due to the resistance of the connections which increases the temperature of the fuse above what it normally would be.

Therefore, in my opinion, the only reason for using a 600-v fuse on a 550-v line is its safe interrupting capacity, and the reason it is not used on a 115-v line is its greater physical size and its higher cost.

FRED E. GOULD

Editor's Note—There has been so much interest in this question, also in Question No. 222, How Prevent Fuses from Blowing?, that we are now making plans for one or more detailed articles on fuses—how they are made, exactly why and how they function, how to use them, sizes and capacities available and so on.

Answer No. 226

Why Do Fans Act Thus if Discharge Is Obstructed?

MAYBE, quoth Malarkey wistfully in the May issue, some reader can explain in a fairly simple way why a centrifugal fan loses its load when the discharge is obstructed and why a propeller type fan increases its load under the same conditions. Malarkey says he can explain it on the basis of the characteristic curves for the two types of fans. But in teaching a class of Navy lads, he says, that explanation doesn't seem to go over so well. He wants something simpler that they can visualize.

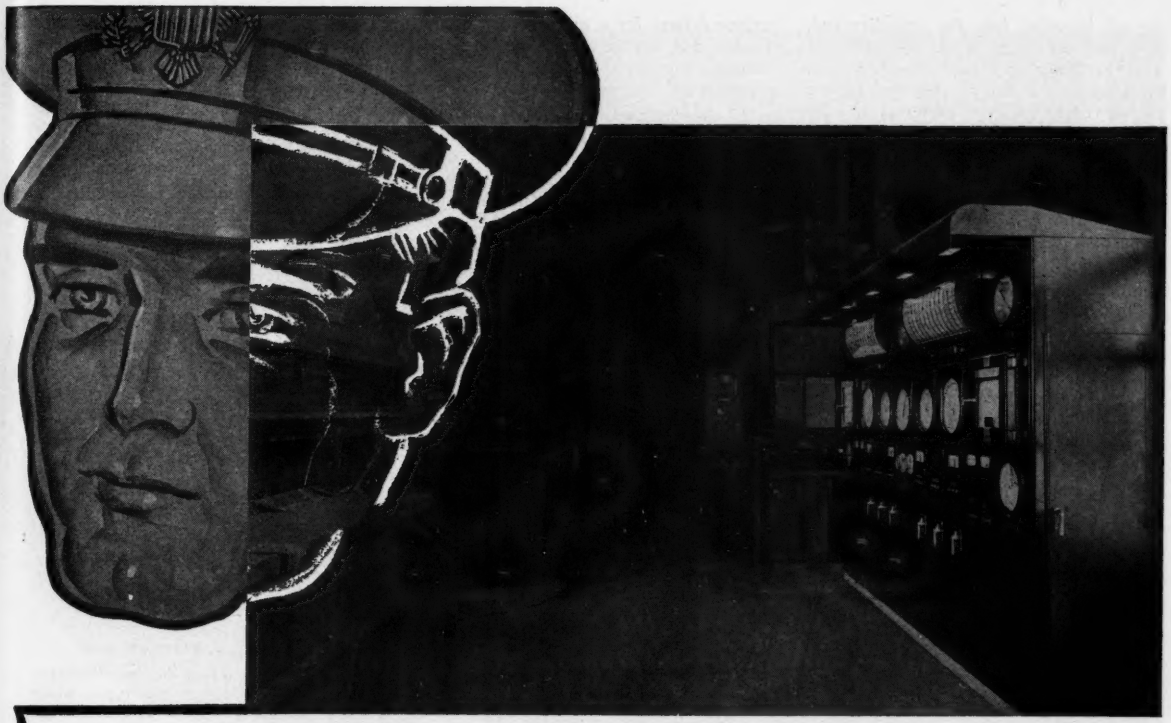
One Is Like a Globe Valve, the Other Like a Non-return Valve

WITHOUT going into a lot of deep theory in fan characteristics and efficiency curves, etc., I believe the simplest way to explain the difference between the action of propeller and centrifugal type fans is to assume them to be the equivalent of a globe valve and a non-return valve. The sketch shows what I mean.

The centrifugal fan is the equivalent of a globe valve in that the air may flow into the rotor and part of it at least may be returned in toward the inlet again, thus setting up eddy currents, as shown by dotted lines on the sketch, but not increasing the load.

The principle of the centrifugal fan is that the wedge of air between the blades has a tendency to be thrown out towards the periphery but, if the discharge is restricted, the wedge of air is only partly discharged.

The propeller type fan must be likened to a non-return valve because



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the air is pulled into the propeller and, once past the blade, it has no outlet but must be "piled up," so to speak, behind the propeller. It can be seen that the air cannot return past the blades at all. So if the discharge is restricted, the pressure behind the blades will build up, thus increasing the velocity of the air at the discharge, thereby increasing the fan load.

Kearny, N. J. GEO. MCNALLY

One Is Like a Screw, the Other Depends on Velocity Head Relations

BECAUSE the pressure differential across either type of fan is very small and the air is compressed but very little, for all practical purposes either type fan may be considered as a pump handling an incompressible fluid.

The blades of a propeller fan are nothing more than the sections of the threads of a multiple screw; they would, therefore, have somewhat the same characteristics as a rotary screw pump, which has a positive displacement.

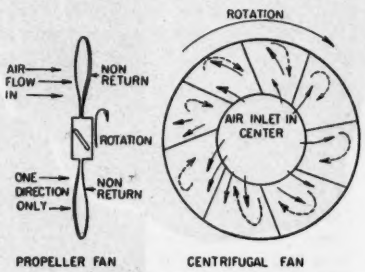
With the discharge closed, the pressure would build up to a maximum on the discharge sides of the blades and since there would be no increase in pressure on the intake sides of the blades, an increase of load on the driving motor or turbine would result. If the fan is turbine driven, for a given setting of the throttle and nozzle valves, the increased loading due to obstructed discharge would cause the machine to slow down.

If the discharge was clear and the intake closed, the pressure on the discharge sides of the blades would drop to atmospheric but a partial vacuum would be created on the intake sides. The pressure difference would again cause increased loading of the driving machine, and slowing down would result if a turbine were the driver, operating with a given throttle and nozzle valve setting as mentioned in the preceding paragraph.

Thus, obstruction of either the intake or discharge on a propeller type fan would result in an increased load on the driving machine as a result of the increased pressure differential across the fan.

The centrifugal fan or pump depends upon the rotation of a mass of air or fluid trapped between the vanes, developing a pressure (velocity head) due to centrifugal force greater than the pressure in the scroll. As fast as this wedge of air is slung out and flows out the discharge, air flows in at the intake to replace it.

If the discharge should become obstructed, the pressure within the scroll would build up until it just balanced the pressure created by the revolving mass of air between the vanes. The air trapped between the vanes could not be slung out, for this would be resisted by the air within the scroll. The loading of a centrifugal fan or pump is dependent upon the friction caused by the quantity of substance being handled as it flows along the vanes. Hence, with no delivery there would be no load other than the friction of the air between the vanes and the air in the scroll, which would be no great amount. Under these conditions, a driving turbine would become unloaded and would overspeed.



George McNally's sketch showing difference in operating principle of two types, which explains characteristic with obstructed discharge

In the event that the intake was obstructed, with the discharge open, a partial vacuum would be created in the intake and a correspondingly lower pressure in the scroll. Due to the lessened pressure in both scroll and intake, there would be much less friction between the air in the scroll and the air between the vanes than there would be in the case of an obstructed discharge. For this condition, a driving turbine would overspeed dangerously.

Some of the advantages claimed for the propeller type fan are that it is:

1. Adaptable to higher rotative speeds because the rotor can be built much stronger and can be balanced much easier than the rotor of a centrifugal fan.

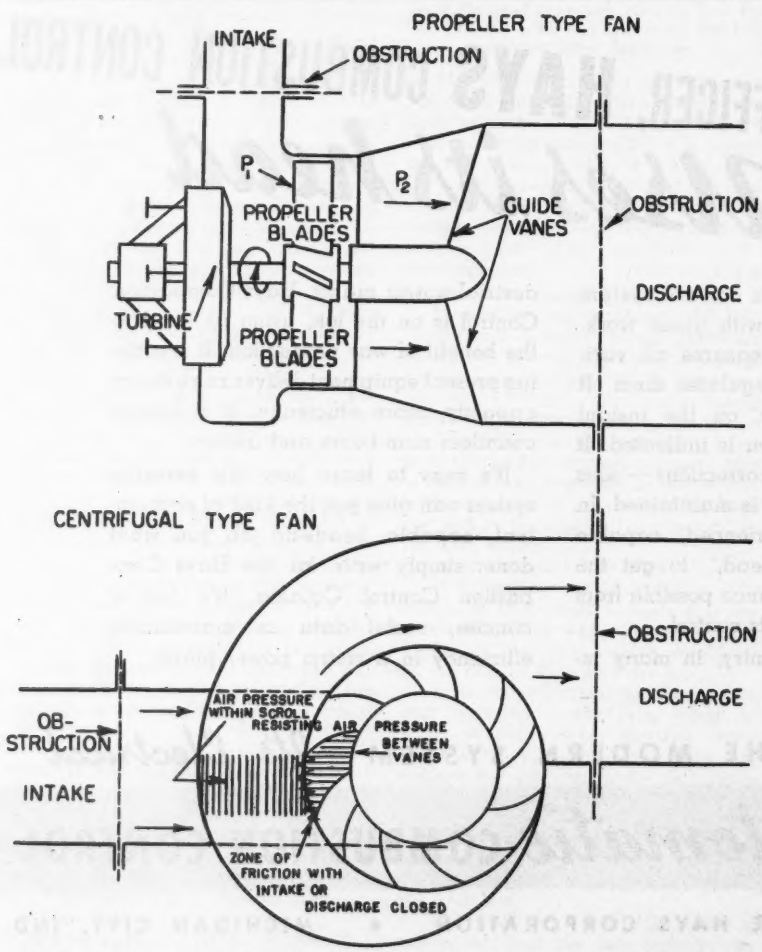
2. Better suited for parallel operation under varying loads, for each fan will handle its relative share of the load.

3. Safer because it has no tendency to unload or run away if intake or discharge are accidentally blocked.

Boston, Mass. E. M. D.

EDITOR'S NOTE — *We have looked through a lot of the textbooks and magazine articles on fans and we can't find any comparison between the operating principles of these two types of fans. Malarkey has looked, too, and says he doesn't know of anything, either simple or technical. Doubtless it exists somewhere—research or test reports in manufacturers' files, perhaps?*

So, before we get through, we think we're going to arrange for an article, by an engineer with a lot of fan experience, explaining exactly why propeller and centrifugal type fans act differently—even though he will have to resort to math and characteristic curves (and maybe a little neuropsychiatry) to do it.



E. M. D.'s diagram showing difference between principles of propeller and centrifugal fans

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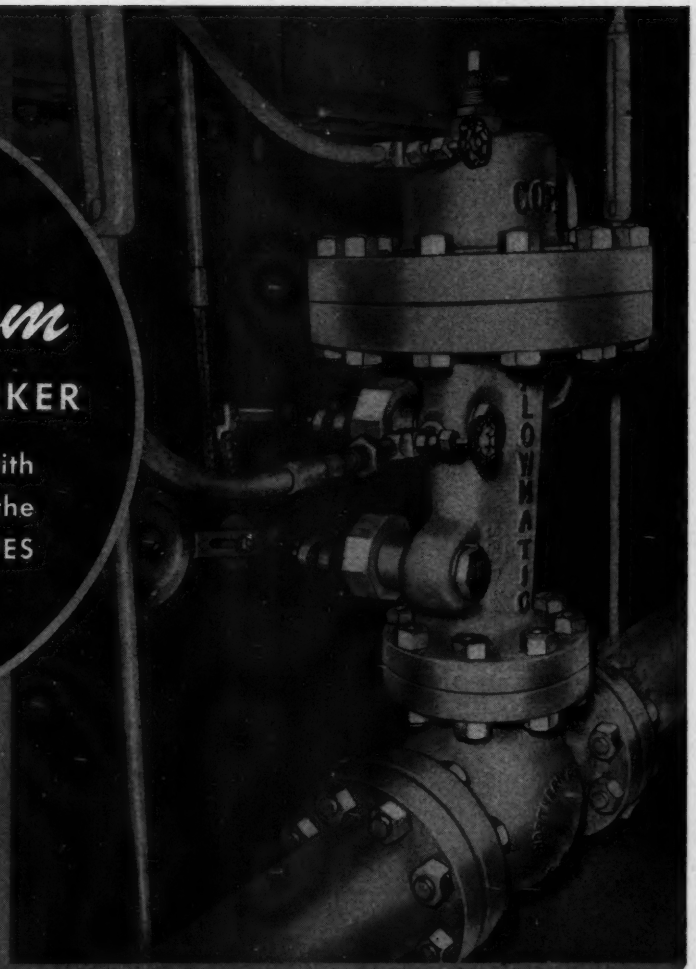
FOR THIS WAR WORKER

168 hours every week with no lost time! That's the record of thousands of COPES Feed Water Regulators.



▲ This direct operated COPES Flowmatic Regulator Valve feeds a 600-pound pressure Vogt Boiler; 90,000 pounds per hour capacity.

ON both land and sea, COPES Feed Water Regulators perform their war jobs consistently and thoroughly. They make boiler operation SAFER, by stabilizing water level within fixed limits. They increase efficiencies of boilers, heaters and pumps; steady the steam pressure, and increase peak capacities. Important at any time, these tasks become doubly so during War.

Why COPES Regulators Stay on the Job

1. *SIMPLE*—Design based on proven mechanical principles that won't fail.
2. *FAST*—Responsive to level changes 5 to 8 times faster than others tested. Speed available where needed.
3. *DEPENDABLE*—Built for hard service and little attention.
4. *SELECTIVE*—Both single element and two element regulators are available, with Thermostats and Valves designed for the specific application.

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LIQUID LEVEL CONTROLS . . . . REDUCING VALVES AND DESUPERHEATERS

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COPES — FEEDS BOILER ACCORDING TO STEAM FLOW-AUTOMATICALLY

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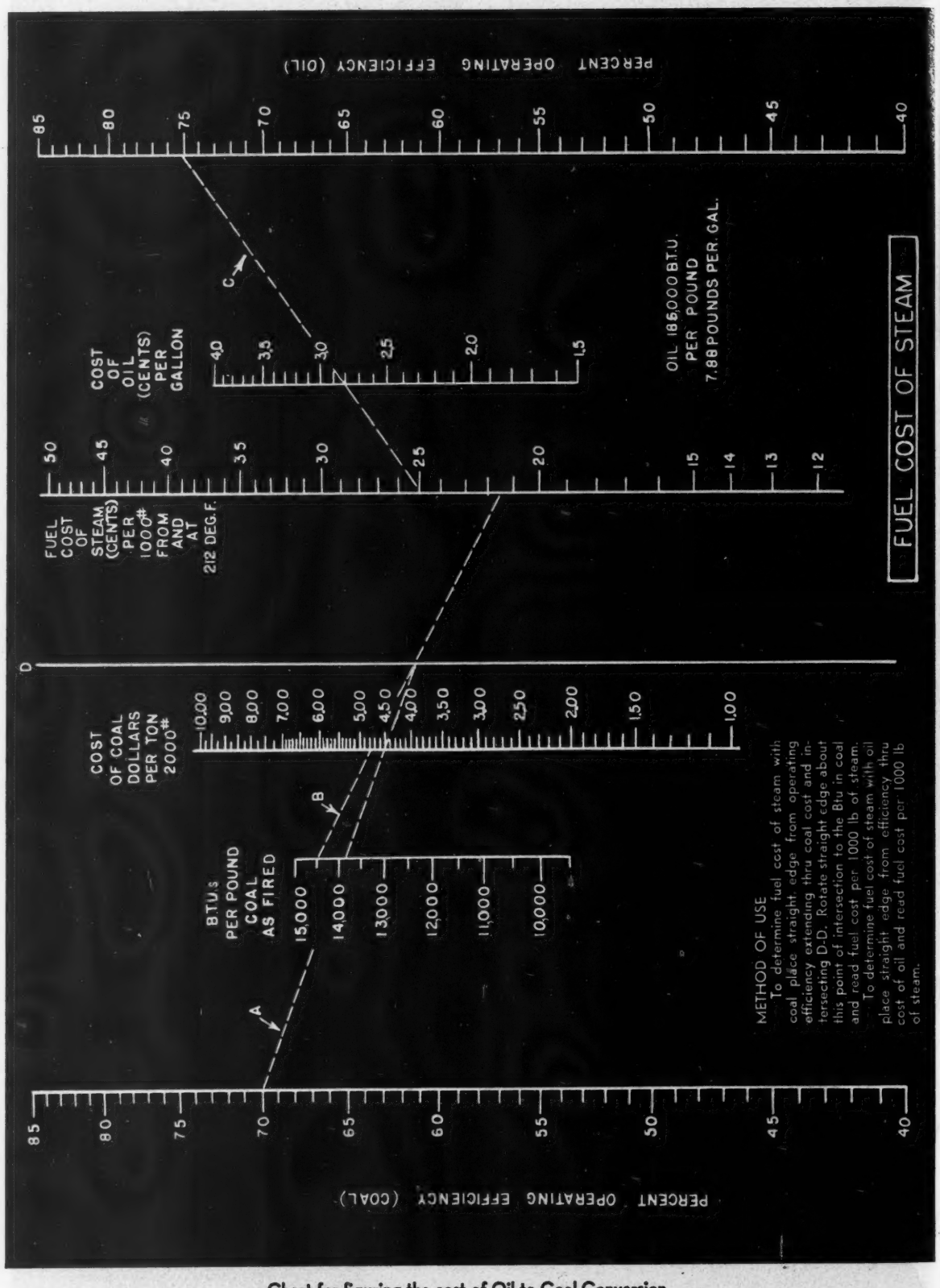

Chart for figuring the cost of Oil to Coal Conversion.
As explained on p 83 this chart gives the fuel costs per 1000 lb of steam for both oil and coal.

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"eliminate high oil consumption . . sludge formation . . frequent overhauls"

Today, municipal equipment in defense areas is carrying "plus loads" that were never even dreamed of yesterday. Engines run longer, carry greater loads and need the right lubricant more than ever before.

The value of engineering "know how" plus the right lubricant was proved recently in a large pumping station in New England. The Winton Diesel engines—source of power for centrifugal pumps—were plagued with bad sludge formations, frequent overhauls and high oil consumption. A Sun Oil Engineer—one of those Doctors of Industry—studied the situation, recommended a change from a competitive lubricant to Solnus Heavy Medium Oil and that proved to be the answer!

Trouble stopped! According to latest reports all parts are perfectly lubricated . . . there are no carbon formations . . . engines are free of sludge . . . oil consumption is at a new low . . . and there hasn't been a replacement or overhaul since Solnus Oils were placed in service.

This is just another one of many cases that are constantly proving the value of these modern diesel lubricants and Sun Service. Both are yours to use to help keep your plant on a "victory schedule." Write for more information today . . .

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SUN INDUSTRIAL PRODUCTS

HELPING INDUSTRY HELP AMERICA

CMP in Full Operation—
What it Means to the Power Engineer

The Controlled Materials Plan, or CMP, is here to stay for the duration. It is the final development of the basic priority structure under which all industry has operated for over two years. This article assumes that the reader, either a utility or an industrial power engineer, already has or can obtain the various CMP regulations and WPB orders applying specifically to the industry his power plant serves and that he has been conducting his operations under them up to this time. One most important change is the raising of the rating assigned to Schedule II activities under CMP5 from AA-2X to AA-2 and of all industries not under either Schedule I or II to AA-5. Other factors of importance are revised regulations on obtaining MRO (maintenance, repair and operating) supplies and clarifications of rules covering minor capital additions. On the whole, this article concludes, under CMP "engineers can look forward with certainty to maintaining their facilities and equipment in top working condition and repair for the duration."

*From the Priority Staff of the Research Institute of America, Inc.**

THE CONTROLLED MATERIALS PLAN shifts into high gear on July 1. Its predecessor, the Production Requirements Plan, has been slowly declining since April 1, and is now officially deceased. The experimental transition second quarter of 1943 has seen many clarifications, simplifications and also complications of the original Controlled Materials Plan announced last November. Technical "bugs" have been ironed out, paper work reduced, exceptional and hardship cases taken care of.

Most important, CMP has now been coordinated with other production controls such as component scheduling, so as to take its place in a single, centrally directed mechanism for regulating all stages of production: raw materials, semi-finished goods, components and sub-assemblies, and completed end products. What has now emerged from the maze of past production controls is a single unified instrument for coordinating all production, both with political and military strategy, and with the available supply of all factors of production—materials, machines, manpower and management.

CMP Is Here for the Duration

Lingering doubts by industry about the practicability of CMP have now largely disappeared. CMP is definitely here to stay for the duration. Whether you like it or not, you must learn to make it work for you. You can do this only by understanding how it ties in with, and how it affects, the basic priority structure with which you have been working for more than two years.

The more important CMP regulations have been revised to incorporate the modifications and refinements which transition quarter experience has shown to be desirable. Here are the chief changes in your CMP operations for the third quarter, classified as they affect (1) Production and manufacture, (2) Construction and (3) Maintenance, repair and operating requirements.

Production

The most striking improvement in CMP production procedures is the expansion of the practice of advance allotments. All the claimant agencies, as well as WPB, are trying hard to eliminate quarterly allotments and applications for allotment in as many cases as possible. Instead, allotments and authorized schedules are usually being issued for a year and occasionally for even longer in advance. Claimant agencies are authorized to make commitments up to July 1944 for steel, copper and aluminum, in quarterly amounts equal to those allotted to each claimant agency for the third quarter. This is a considerable step forward over the previous arrangement, whereby claimant agencies could allot only 80 per cent for the first subsequent quarter, 60 per cent for the second subsequent quarter and 40 per cent for all later quarters.

Under the new set-up, schedules and allotments for future quarters usually do not even have to be reaffirmed each quarter. Any downward change in requirements or programs will be made by specific cancellation of allotments on Forms CMP-201 and 201-A. On the other hand, boosts in requirements or programs will be handled by interim increases in allotments on Forms CMP-200 and 200-A.

Chief benefit of this change is that purchasing is now feasible much further in advance than previously possible. Also, since advance quarterly allotments will not have to be renewed during subsequent quarters, the volume of CMP paper-work for manufacturers will be correspondingly reduced.

Allotments on Quarterly Basis

Another help in cutting down paper-work is the placing of allotments entirely on a quarterly basis, eliminating the former monthly percentage restrictions on the placement of orders for controlled materials. Reliance will be placed on WPB inventory and scheduling controls to see that excessive backlogs of materials and parts are not accumulated by manufacturers. However, inventory control is to be slightly relaxed as far as frozen materials are concerned. Frozen inventories will be "ex-quota" for the third quarter, and the general 60-day inventory ceiling under CMP Regulation 2 need not be calculated to include any amount of frozen materials. Unlimited amounts of such materials which

*Founded in 1935, the Research Institute of America, Inc., attempts without economic, political or social bias to meet the problems created by the growth of Government regulations for its more than 30,000 members.

TUBE-TURN WELDING FITTINGS—RANGE OF SIZES

Type of Fitting	Description	Standard Weight	Extra Strong	Schedule 160	Double Extra Strong	Light Gauge: Nominal Pipe Size	Light Gauge: Iron Pipe Size
Elbows	90° Long Radius	½"-24"	¾"-24"	1"-14"	1"-8"	4"-24"	3"-12"
Elbows	90° Short Radius	1"-30"	1½"-30"				
Elbows	45° Long Radius	½"-30"*	¾"-30"*	1"-14"	1"-8"	4"-24"	3"-12"
Returns	180° Long Radius	½"-24"	1"-24"	1"-14"	3"-8"	4"-24"	3"-12"
Returns	180° Short Radius	1"-30"	1½"-30"				
Returns	180° Extra Long Radius	1"-2½"	1"-2½"				
Tees	Straight	½"-24"	½"-24"	1"-12"	1"-8"		
Tees	Reducing Outlet	¾x⅜-24x20	¾x⅜-24x20	¾x½-12x10	1x⅜-8x6		
Reducers	Concentric & Eccentric	1x⅜-24x20	1x⅜-24x20		1x¾-8x6		
Caps		¾"-24"	¾"-24"		1"-8"		
Stub Ends	Lap Joint	¾"-24"	¾"-24"				
Nipples	Shaped, 90° to Header	1¼"-12"	1¼"-12"				
Nipples	Shaped, 45° to Header	1¼"-12"	1¼"-12"				
Saddles		2"-24"					
Laterals	Straight	1¼"-24"	1¼"-24"				
Laterals	Reducing	1¼"-24"	1¼"-24"				
Crosses	Straight	¾"-24"	¾"-24"				
Rings	Welding	¾"-12"	¾"-12"				
Sleeves	Welding	2"-24"					

*30" size short radius.

SUPER Tube-Turn 45° long radius elbows, 90° long radius returns, and 180° long radius returns available in both Standard weight and Extra Strong in sizes from 3" to 12".

Tube-Turn welding fittings and flanges conform to applicable ASA and ASTM Standards. For further details please refer to Tube Turns catalog and data book No. 111.

TUBE-TURN FORGED STEEL FLANGES—RANGE OF SIZES

	150 Lb.	300 Lb.	400 Lb.	600 Lb.	900 Lb.	1500 Lb.	2500 Lb.
Welding Neck	½"-24"	½"-24"	½"-24"†	½"-24"	½"-24"*	½"-24"	½"-24"
Slip-On	½"-24"	½"-24"	½"-24"†	½"-24"	½"-24"*	½"-24"	½"-24"
Lap Joint	½"-24"	½"-24"	½"-24"†	½"-24"	½"-24"	½"-24"	½"-24"
Threaded	½"-24"	½"-24"	½"-24"†	½"-24"	½"-24"*	½"-24"	½"-24"
Blind	½"-24"	½"-24"	½"- 4"	¼"-3½"			
Socket Type	¼"-24"	¼"- 4"	¾"-24"	¾"-24"	¾"-24"	¾"-12"	¾"-12"
Reducing-threaded or slip-on	¾"-24"	¾"-24"	4"-12"	4"-12"	3"-12"	1"-12"	
Orifice—threaded		1"-24"					
Orifice—slip-on		1"-24"	4"-12"	1"-12"	3"-12"	1"-12"	
Orifice—welding neck		1"-24"	4"-12"	1"-10"	1"-10"	1"-10"	
Long Welding Neck	1"-24"	1"-24"	1"-10"	1"-10"			

†Dimensions on sizes thru 3½" same as for 600 lb. flanges.
*Dimensions on sizes thru 2½" same as for 1500 lb. flanges.

TUBE-TURN
TRADE MARK
Welding Fittings and Flanges

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are registered on the books of the Steel Recovery Corp. may be purchased by any firm operating under CMP.

The Controlled Materials List and B Products List have undergone only minor changes for the third quarter. A few materials, like carbon and alloy steel die blocks and track accessories, have been added to the list of controlled materials, while ammunition caps, discs and slugs have been removed. After considerable grumbling about the arbitrary and illogical nature of many of the designations on the B List, industry has generally adapted its bills of materials and accounting techniques to the CMP classifications. Any radical change, particularly in the B List, while it might be regarded as theoretically desirable, would create so much havoc with established business routine that it now seems very unlikely.

Construction

CMP Regulation 6, last of the basic CMP documents, is largely a codification of provisions in the other CMP regulations affecting construction and facilities. The modifications of CMP procedure for the third quarter, described above, apply equally to construction activities. However, the general stop-construction and facilities order of the War Production Board, issued in May of this year, and cutting back output of machinery, machine tools and facilities, except in cases of clearly proven need, has turned the primary attention of power plant engineers to the provisions of the Controlled Materials Plan governing maintenance, repair and operating requirements.

Maintenance, Repair and Operating Supplies

Control over maintenance, repair and operating supplies has been one of the toughest problems the War Production Board has had to tackle. Practically every type of business enterprise requires such supplies, and uniform provisions governing their allocation and distribution have so far, despite many thoroughgoing efforts, been unobtainable. The situation as CMP gets into full swing is accordingly one in which CMP Regulation 5 and 5A are the basic overall documents covering most business units, while special P and U orders take care of industries and activities with distinctive maintenance, repair and operating problems. Power plant engineers should therefore continually keep in mind that, despite the wide applicability of CMP regulations, there are a number of important P and U orders, both old and new, which either supplement or supersede CMP controls over MRO. In setting up plans for your MRO operations under CMP, be sure to check any P or U order applicable to your activities to see whether it is merely supplementary to CMP Regulation 5 or 5A, or whether it supersedes CMP completely. Note CMP 5 or 5A preference ratings replace the ratings assigned by any P order for MRO supplies, except in those cases where amendments to such orders specifically provide to the contrary.

Similarly, if any L, M or E order affects your operations, remember that when any such order requires you to file applications or reports on your use of or requirements for maintenance, repair or operating supplies, or limits the amount of such supplies you are permitted to acquire or use, you must continue to comply with the provisions of the order until they are either specifically modified or revoked. Moreover, when any E, L or M order assigns a specific preference rating to deliveries of any particular material you use, this preference rating supersedes any preference rating assigned by either CMP Regulation 5 or 5A.

Some of the major P and U orders superseding CMP controls over maintenance, repair and operating supplies are: P-89 (Chemical industries); P-98-b (petroleum); P-115 (canning plants); P-118 (dairy and eggs); P-126 (air conditioning); P-133 (electrical equipment); P-136 (metal scrap processing); P-139 (textile and leather manufacturers); P-141 (public sanitation services); U-1 (electric, gas, water and steam utilities); U-3 (telephone and communications system); U-4 (wire, telegraph, cable services).

Ratings Raised

The most important third quarter change in MRO regulations for those industries operating under CMP Regulation 5 is the raising of the rating assigned to Schedule II activities from AA-2X to AA-2, and the raising of the rating assigned to those activities not included in either Schedules I or II from A-10 to AA-5. These boosts in ratings will in many cases cause purchases of maintenance, repair

MAKE CMP WORK FOR YOU

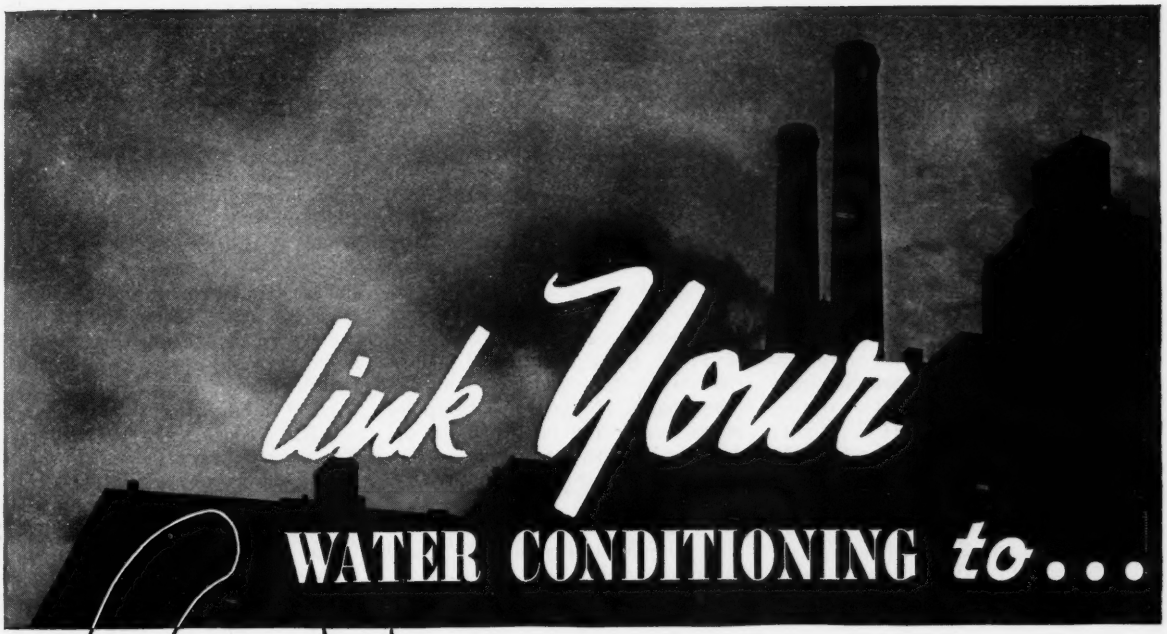
(Editorial Comment)

By this time you have probably learned, after much groaning and cursing of the Washington bureaucrats, the advantages of concentrating on what you *can* do under CMP rather than on what you *cannot* do. Believe it or not, the object of WPB and CMP is to help increase production, not to hamper it. They know that your power plants must be kept running at maximum capacity in order to do this.

The recent up-rating of all industries in Schedule II to AA-2 and of others to AA-5 should give many engineers a lift. As this article explains, this revision means that engineers now can be reasonably sure for the first time of getting MRO supplies at the time they are needed. It also permits them to take advantage of retroactive provisions on undelivered orders. Power engineers should give careful attention to these revisions, for they may eliminate many of the handicaps under which engineers have been laboring.

Electric, water, gas and steam utilities, despite their very considerable difficulties, are still in the best position under CMP. Engineers in this field not directly concerned with compliance will get help from this article in understanding the general CMP procedure. Another very valuable interpretation for such engineers is A Guide to U-1 in the May 29, 1943 issue of Electrical World. This guide is a "trot" or "pony", which translates Utilities Order U-1 from legal into general and engineering terms.

Obviously this type of interpretation cannot be made for all industrial power plants although they may have common technical problems. They do not sell their product directly, however, but only as part of the product of their industry, hence their CMP procedures and ratings are determined by the position of that particular industry in Schedules I and II. Industrial plants selling some of their steam and power may become "producers" or utilities under U-1 by applying for and obtaining permission to come under it. Industrial power engineers, therefore, must study all the regulations applying to the specific industry they serve. Such study, combined with the general provisions of CMP 5 and the points covered in this article, should enable engineers to make CMP really help them.—C. R. E.



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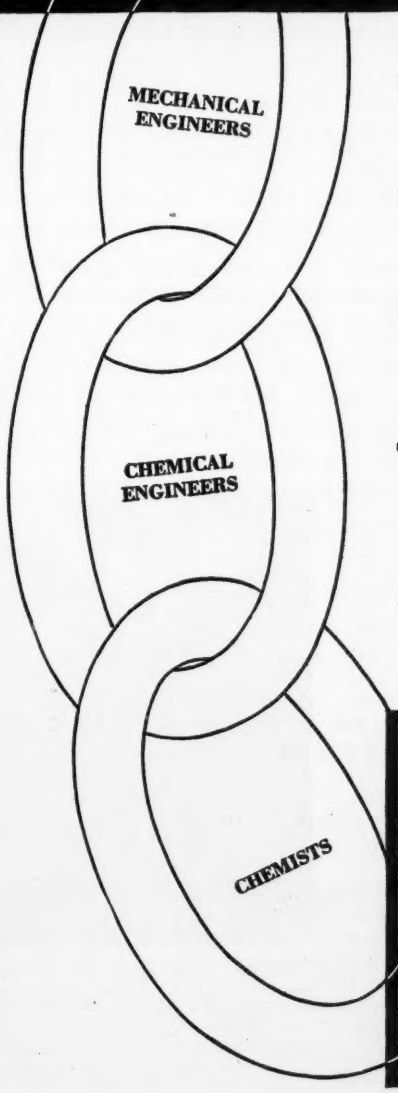

a technical organization which understands *all* water problems and has the facilities to effect an economical solution.

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7-BA-2

and operating supplies to take precedence over orders for production materials. Now that the AA-2 rating has been restored as an intermediate between AA-1 and AA-2X, many important production orders rated AA-2X, will have to be rescheduled behind MRO orders rated AA-2. The jump in rating for industries formerly rated A-10 is even more pronounced. For the first time such industries have a reasonably good chance of getting their maintenance, repair and operating requirements at approximately the time they are required.

Large users of MRO supplies operating under CMP-5 should take advantage of the fact that the boost in preference ratings resulting from its recent revision can be made retroactive in effect. The new AA-2 and AA-5 ratings apply not only to MRO orders placed after May 14, the effective date of the amended regulation, but they can also be made to apply to undelivered orders placed before that date with your old AA-2X or A-10 ratings. Moreover, the effective date of such up-rating is the date on which a particular order was originally received by your supplier. This up-rating is not automatic. It goes into effect only when the MRO purchaser notifies his supplier in appropriate manner.

The following steps are necessary to effect an up-rating for MRO purchases: Write or wire the suppliers who have your unfilled MRO orders on their books, informing them that your previous rating (AA-2X or A-10) is cancelled and replaced by your new MRO rating (AA-2 or AA-5). In your communication, be sure to list the numbers of the purchase orders on which the ratings are changed. Instruct your suppliers to file your letter or telegram with the original purchase order. As an alternative you may, if you wish, furnish a supplier with a duplicate purchase order carrying the new rating and the appropriate MRO endorsement.

Another important change in the regulation provides that a repair shop or similar business may obtain MRO materials on the ratings available to their customers. Whenever this is done, the customer's quota must be charged rather than his own.

Another improvement in the regulation is the liberalization of the exclusion of paper items from the definition of MRO supplies. Ratings assigned under the order may now be used for the purchase of carbon paper, tracing paper, graph paper, engineering paper and chemically treated paper for engineering use.

Procedure for getting additional MRO supplies is also facilitated by the revised regulation. If you cannot get your necessary supplies with the rating assigned to you, or if you are not listed on Schedule I or II and find that you cannot get the controlled materials you need from distributors or warehouses, you may now apply to the nearest local WPB office on the standard form for special priorities assistance, PD-1A. On the other hand, if you have to spend more money for maintenance, repair and operating supplies than the quantity limitations of the order permit, it is still necessary for you to file a letter in triplicate with the War Production Board in Washington.

The provisions of the regulation covering minor capital additions has been clarified without any appreciable change in the intent of the original regulation. The $500 limitation (excluding purchaser's cost of labor, usually for installation) is specified to cover any one *complete* capital addition. A "complete capital addition" is defined as any group of items customarily purchased together, all the items of which would normally be purchased as a part of a single project or plant. Moreover, wherever the capital addition involves construction, authorization to construct must first be obtained to the extent required by Conservation Order L-41, or other applicable order or regulation.

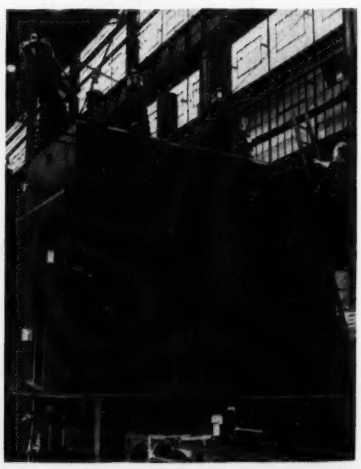
As a result of all these changes, CMP Regulation 5 is more than ever the most generous of all the basic priorities regulations. It provides a simple method of applying relatively high preference ratings with comparatively few restrictions, and with no filling in of special application or report forms. Under its provisions, engineers can look forward with certainty to maintaining their facilities and equipment in top working condition and repair for the duration.

New Transformer's Form-Fit Tank Saves Space

TRANSFORMER EXPERTS recently tackled the problem of building a 37,500-kv-a transformer with the smallest possible dimensions so it could pass through the hatch of a ship. Weight was also an important consideration so the oil filled space between core and tank was held to a minimum. The net result was a form-fit tank. First, a base was made to fit and enclose the section below the laminations, according to Westinghouse engineers. The transformer was then fastened to the base and the core and coils were thoroughly dried and treated. The main tank was constructed broad at the bottom to accommodate the laminations; it was made smaller at the top to equal the dimensions of the base. The two sections were welded together, making a hermetically-sealed unit which was filled with oil.

The resulting transformer weighs 19 per cent less than a standard forced-oil-cooled unit. The difference results from a 10 per cent saving in tank metal and a 33 1/3 per cent saving of oil. Occupying a floor space measuring 7 by 16 ft instead of 10 by 17½ ft, the area saved amounts to 37 per cent. If radiators with the conventional form of tanks had been used the floor space would have been 16 by 23½ ft and the total weight would have increased 50 per cent. The standard design would have required pounds of additional steel and 4600 gal more oil.

The new transformer tank has other merits which will probably lead to its use in peacetime service. The core and coils may be repaired by draining off the relatively small quantity of oil, removing the weld around the base and raising the tank. This exposes important parts of the core and coils and makes it unnecessary to handle or change the position of the heavier parts of the transformer.



Transformer rated 37,500 kv-a, with tank in position on base, designed with minimum dimensions to pass through the hatch of a ship. Westinghouse experts say it is unnecessary to handle or shift the heavier parts of the transformer in making repairs to core and coils

Wilson Trigger-Power Cleaner with Wilson Vibromatic Attachment

HERE'S SOMETHING THAT'S REALLY NEW IN TUBE CLEANERS

(Patents Pending)

Wilson Trigger-Power Tube Cleaner

The Wilson Trigger-Power Cleaner is an entirely new and revolutionary type of tube cleaner, especially designed to clean the small diameter (3/8" I.D. to 1 1/4" I.D.) straight tubes of condensers, heat exchangers and similar apparatus *quickly, thoroughly, safely* and *without damage*. It removes either soft, gummy, or moderately hard deposits from small diameter straight tubes at speeds never before attainable, and renders obsolete the old method of using ordinary tube cleaners operating at slow speeds and equipped with ordinary tube "drills". Its use makes possible the rapid cleaning of tubes heretofore considered unprofitable to clean because of the time and trouble involved. In addition, tube bundles can often be cleaned without removal from the shell.

For cleaning tubes which are partially or totally plugged with especially hard deposits such as "petro-coke", hard silica scale, etc., the use of the Wilson Vibromatic Attachment in conjunction with the Wilson Trigger-Power Cleaner makes the operation remarkably easy and rapid. The Attachment gives the special Wilson "Cutter-Bit" the combined movement of a rotary tube cleaner and a percussion hammer. It adds a series of rapid blows to the rotation of the "cutter-bit" and at the same time enables it to obtain a good "bite" on the deposit. This dual-action of the "cutter-bit" quickly breaks up and removes the hardest and heaviest deposits. The Wilson Vibromatic Attachment is operated by the air or steam used as scavenging agent for cleaning the tube of debris, and its use in no way reduces the power of the Trigger-Power Cleaner's motor.

Send for Bulletin No. 63 which fully describes this remarkable tube cleaner.

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ASHVE Summer Meeting

Fuel rationing has stressed economy in application of heat for comfort. Home insulation, conversion from oil to coal, more efficient combustion, more careful application of heat to rooms and added clothing are suggested methods for meeting pending fuel shortage

CONGREGATED in Pittsburgh for the Semi-Annual Meeting of the American Society of Heating and Ventilating Engineers, nearly 300 of the country's foremost heating engineers devoted three days, June 6 to 8, to the discussion of problems having to do with conservation of fuel and the economics of heating for human comfort. The hardships endured during the past winter due to fuel shortages in some sections of the country have stimulated planning for the winter to come and, like so many of the problems initiated by war conditions, their solutions will be greatly aided by the application of sound engineering principles.

That the country came through last winter without disastrous results, though many were seriously inconvenienced by lack of heat, is no assurance that the coming winter will not present more severe conditions, was pointed out by Howard Coonley, director of the Conservation Division of the War Production Board in the keynote address of the meeting. He indicated his belief that one of civilization's greatest contributions to mankind is the provision of proper thermal environment regardless of natural weather conditions.

Winning of the war demands careful allocation of the nation's available fuel supply to the various necessary uses, and those responsible for the burning of various types of fuel will be required to use it in the most efficient manner. In the heating field alone, a one per cent saving would amount to 1,720,000 bbl of oil and 1,800,000 tons of coal. Authorities were quoted by Mr. Coonley who claim that in District No. 1, where oil heated homes are most numerous, a saving of six per cent in oil fuel could be made by weather-stripping the homes which lack this form of insulation. In many homes, proper insulation of walls and ceilings would save 40 per cent of the fuel bill. Proper management of home heating systems would save more than 10 per cent of the fuel bill.

As seen by Mr. Coonley, the problem confronting the heating industry breaks down into the following four parts: 1. Increasing the efficiency of the fuel consuming unit and heating system. 2. Preventing heat losses. 3. Relieving oil consumption in critical areas by conversion to coal. 4. Reducing total fuel consumption by eliminating unnecessary lighting, eliminating casual heating of non-residential buildings and proper care of portable radiant heating units.

Heating engineers have gone a long way toward the solution of all parts of the problem outlined by Mr. Coonley, not that they are satisfied that improvements cannot be made in the practice of heating but so far as principles known to the profession are concerned, little advancement is now in sight other than the perfection of present practice. It was, therefore, to a study of the technical problems of heating that principal attention was given at this meeting.

Panel Heating

Among the newer systems of heating is that known as panel heating in which heating is accomplished by heating panels embedded in ceilings, walls and floors. H. F. Randolph and J. B. Wallace reported results of an investigation they have conducted to compare calculated requirements of a panel heating system using warm air as the heating medium and ceiling panels as radiators, with actual operating requirements. This system was installed in a modern two story and basement residential building erected in 1941, and the authors reported that the calculated panel size based on heat loss of building met the observed requirements. Comfort conditions were maintained, without altering the thermostat setting, through a wide range of fluctuation of outdoor temperatures, due to narrow limits within which mean radiant temperature was maintained. Evidence secured by this investigation indicates that present methods of calculating requirements are available for predicting comfort condition with panel heating systems.

Moist Air Properties

One of the subjects upon which research is being conducted under the sponsorship of ASHVE in cooperation with Towne Scientific School has to do with the thermodynamic properties of moist air. In this third progress report, final values of the interaction constant for moist air were reported. Conclusions have been drawn that the various thermodynamic properties of moist air can be calculated from present knowledge of the interaction constant for pressures possibly as high as 100 atmospheres.

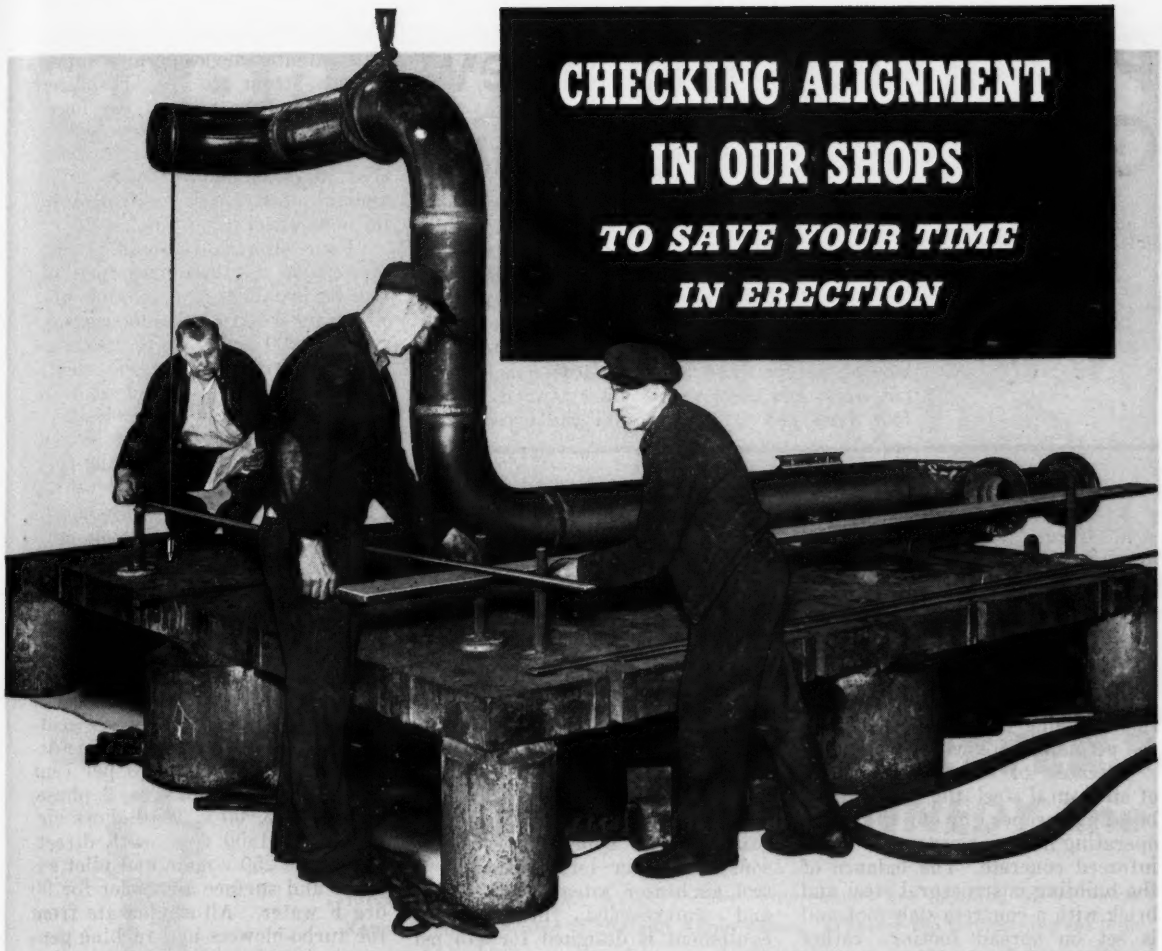
James N. Livermore, in reporting on his study of actual vs. predicted cooling load on an air conditioning system, stressed the importance of well considered design assumptions. Some of these assumptions, those that pertain to the use of the building, such as the number of occupants, are the responsibility of the owner of the building, others are the responsibility of the designer. Extremely refined calculations for total cooling load are not justified when assumptions and approximations enter into the calculations. Calculating cooling load due to lighting needs further investigation. Calculated peak loads were generally higher than the measured loads.

In the field of cooling towers, L. M. K. Boelter and S. Hori reported results of research work they had conducted to determine the effects of changing the water pressure on the spray nozzle and changing the number of nozzles. They also gave test results which show the beneficial effect of placing screen plates and screens below the nozzles.

Down-Draft Hand Fired Furnaces

Tests conducted by J. R. Fellows and J. C. Miles on a domestic size furnace of the hand fired type burning high-volatile Illinois coal on the down-draft principle show overall efficiency results ranging from 71.6 to 84 per cent. These results were obtained without the production of smoke. The authors report that a down-draft conversion burner can be installed in a conventional furnace in a few minutes without any changes in the furnace other than the insertion of the burner through the firing door opening. One such conversion furnace effected a saving, according to test results, of over 24 per cent in fuel burned, in comparison with another furnace operating under identical conditions but without the burner.

(*Continued on Page* 128)



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Misalignment and dimensional variation in piping subassemblies delivered to the job can cause considerable trouble and expense . . . and much lost time in field erection. It is a nuisance you need not tolerate.

Midwest takes no chances in this important matter. Every pre-fabricated subassembly is checked for dimension and alignment with utmost care. Any inaccuracies which this check discloses are corrected before shipment is permitted. As a result, Midwest Pre-Fabricated Piping is erected easily and rapidly.

Other time-saving and trouble-saving advantages of Piping by Midwest are the thorough cleaning to remove all scale, dirt, etc. before shipment . . . and the most careful inspection and shop testing.

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Midwest Piping Service can be used to advantage whenever you need piping . . . whether a simple pipe bend or a complex high pressure piping job. Three modern fabricating plants are strategically located to serve you . . . and an experienced Erecting Division will take full responsibility for a complete piping installation.

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Main Office: 1450 South Second St., St. Louis, Mo.
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Sales Offices: Chicago—645 Marquette Bldg. • Houston—229 Shell Bldg. • Los Angeles—520 Anderson St. • New York—(Eastern Division 30) Church St. • Tulsa—533 Mayo Bldg.

Power for the New Geneva Steel Mill

Capacity of 1,200,000 lb an hour of 475-psi, 760-F steam in 5 boilers and 50,000 kw of electric power in a single turbine generator is provided in power plant now being erected as part of Columbia Steel Co.'s new $150,000,000 steel mill at Geneva, Utah, the largest integrated steel mill west of the Mississippi. The power plant will also supply blast furnace blowing air for three furnaces, large quantities of mill water and other services, is equipped to burn four fuels and is tied in with the local utility.

AT GENEVA, Utah, Columbia Steel Co., Defense Plant Division, U. S. Steel subsidiary, is building the largest steel mill west of the Mississippi. To service three blast furnaces, nine open hearths, plate mill, and structural mill, a power station, which is a combination electric power, blast furnace blowing, and water pumping station, is being erected, as shown in the accompanying view.

Because of the critical nature of structural steel, the power plant building proper, up to the main operating floor, is constructed of reinforced concrete. The balance of the building is structural steel and brick with a concrete slab roof and is set on spread footings rather than piling. Ventilation is provided by forced draft fans on the boilers. Outside air is brought in through numerous louvers.

Tests indicated that 1,200,000 lb per hour of steam generating capacity would be needed. Two boilers, each with a capacity of 150,000 lb per hour, equipped to burn coke breeze and blast furnace gas, and three boilers of 300,000 lb per hour capacity each, equipped to burn coke oven gas, blast furnace gas, and pulverized coal, are being installed. This permits consumption of by-product fuels available and also makes up any shortage of by-product fuel with purchased fuel.

Steam generating units each consist of a Babcock & Wilcox Co., Stirling type boiler, superheater, constant steam temperature control, air heater, integral economizer and water-cooled furnace. The equipment is designed for 475 psi operating pressure and 760 deg F total steam temperature. A complete Republic automatic combustion control for gaseous fuels is being provided.

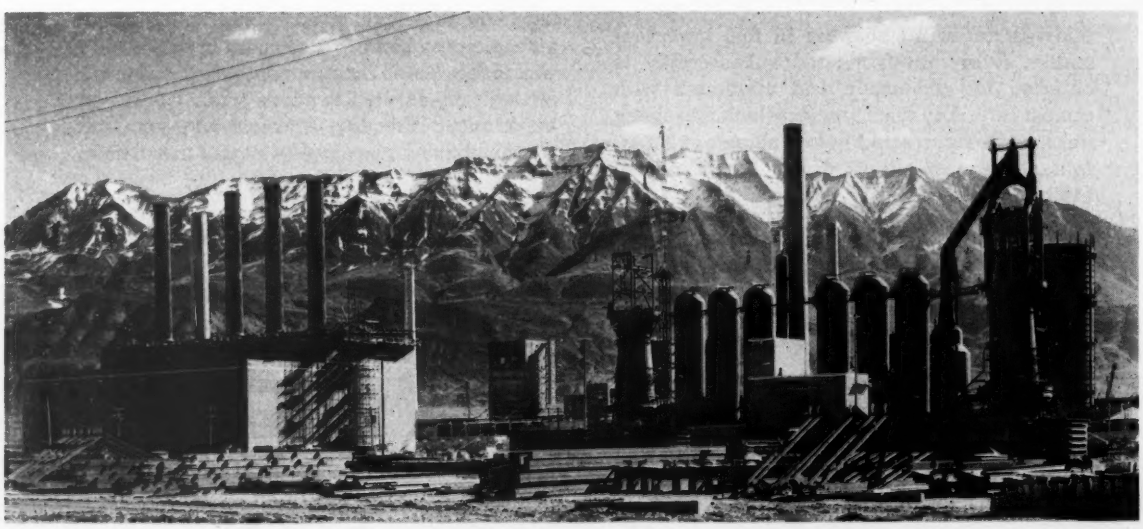
Steam temperature is controlled automatically by an attemperator. This patented device permits superheated steam to be by-passed through a tube nest in the lower economizer drum. It is cooled before mixing with the steam delivered to the main header. The amount of steam is controlled by its temperature.

Four Ingersoll Rand turboblowers for the three blast furnaces will be installed, thus making provision for a spare. The blowers are rated 95,000 cfm at 35 lb discharge pressure with atmospheric conditions of 110 deg F and 25.3 in. barometer. Blast piping between the blowers and furnaces is arranged so that any one of the four blowers can blow any one of the three blast furnaces. The equipment operates full condensing, with all condensate returned to the boiler feed water system.

General Electric Co. is furnishing the turbine generator. The turbine, a single-casing, condensing unit taking throttle steam at 450 psi gage 750 F, is designed for 4 point extraction for feedwater heating purposes. The generator is designed for 50,000 kw, 80 per cent power factor, 62,500 kva, 3 phase, 60 cycle. 13,800 v, 9/10 short circuit ratio, 1800 rpm, with direct-connected, 250 v main and pilot exciters and surface air cooler for 90 deg F water. All condensate from the turbo-blowers and turbine generator is returned to a deaerating feedwater heater.

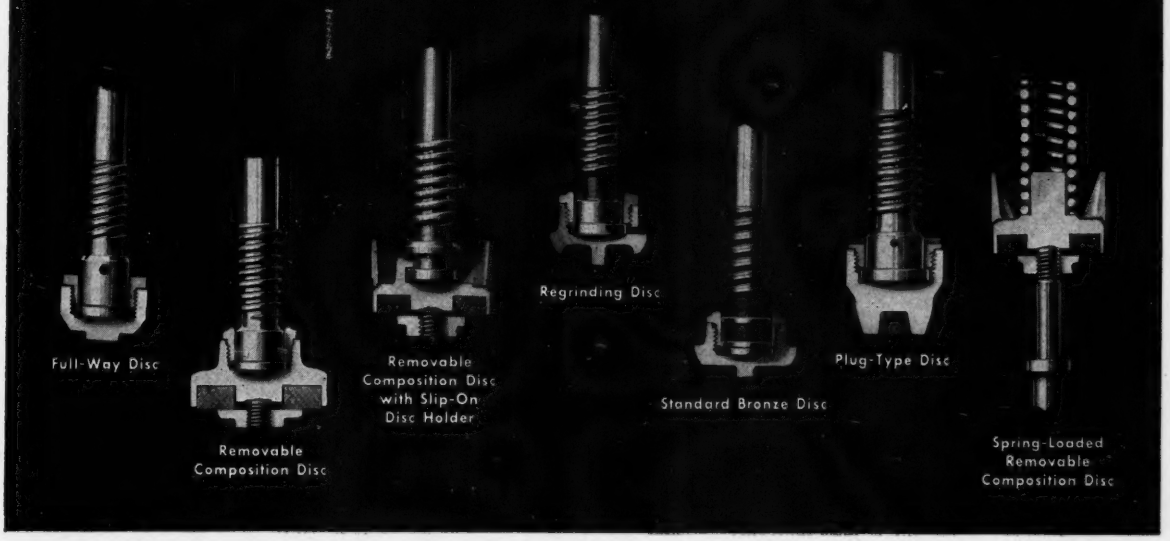
Water pumps are located in a pit in the turbine room basement. Two pumps are motor driven and

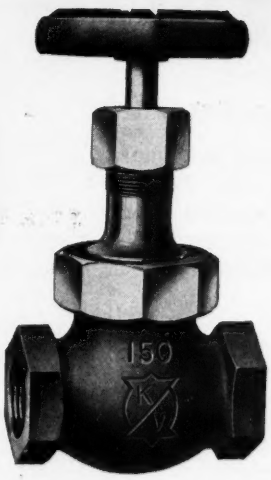
(*Continued on Page* 118)



Recent view of Geneva steel mill under construction, showing combination steam, electric power, blast furnace blowing and water pumping station at left, No. 1 blast furnace nearing completion at right

GLOBE VALVE DISCS





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Precisely the right discs for all regular requirements are included in the large Kennedy line of Bronze Globe and Angle Valves. Whether the service involves high temperature, high pressure, extreme throttling, severe wear, or other operating conditions, you will find a Kennedy disc design that assures best results and longest possible wear. Kennedy Bronze Check Valves, too, are made with a variety of discs for a wide range of requirements.

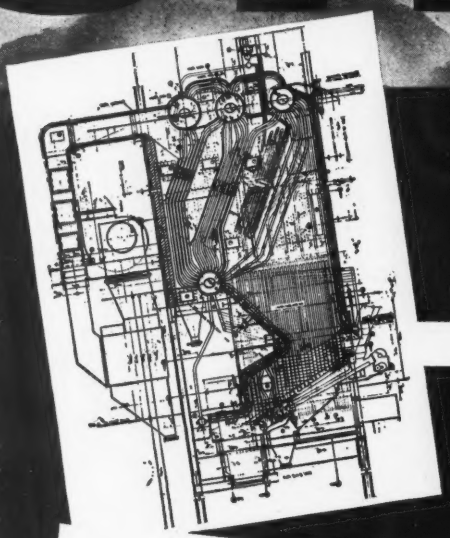
While it may be difficult for you to obtain bronze valves today, it will be advisable for you to bear in mind the exceptionally large extent of Kennedy Valve designs, for the Kennedy line of iron body gate, globe angle and check valves is similarly extensive. All of the many types of Kennedy Valves and Pipe Fittings are described in a comprehensive and conveniently arranged 240-page catalog which every engineer should have. Your copy will be mailed promptly upon request.

THE KENNEDY VALVE MFG. CO.
ELMIRA • NEW YORK

KENNEDY *valves... pipe fittings... fire hydrants*

STEAM

for

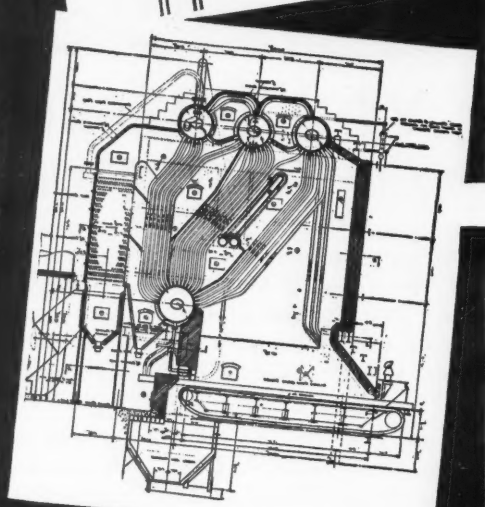


POWER

SOUTHERN COLORADO POWER COMPANY
Pueblo, Colo.

90,000 lbs. steam per hour Vogt LE type bent tube boiler with underfeed stoker. Water walls and economizer. Design pressure 525 lbs. Total steam temperature 750 degrees F.

•

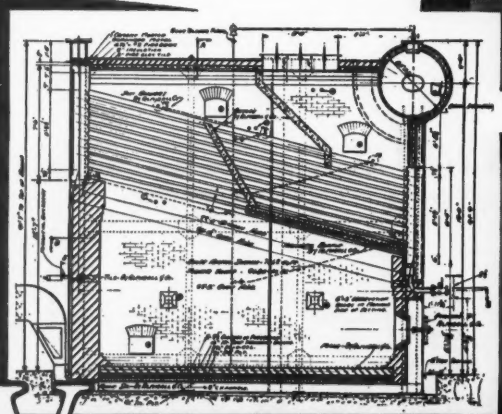


PROCESS

IN A LARGE MID-WESTERN STEEL MILL

Two 105,000 lbs. steam per hour Vogt LE type bent tube boilers with chain grate stokers and economizers. Design pressure 225 lbs. Total steam temperature 550 degrees F.

•



HEATING

CRIMINAL COURTS BUILDING AND JAIL
New York City

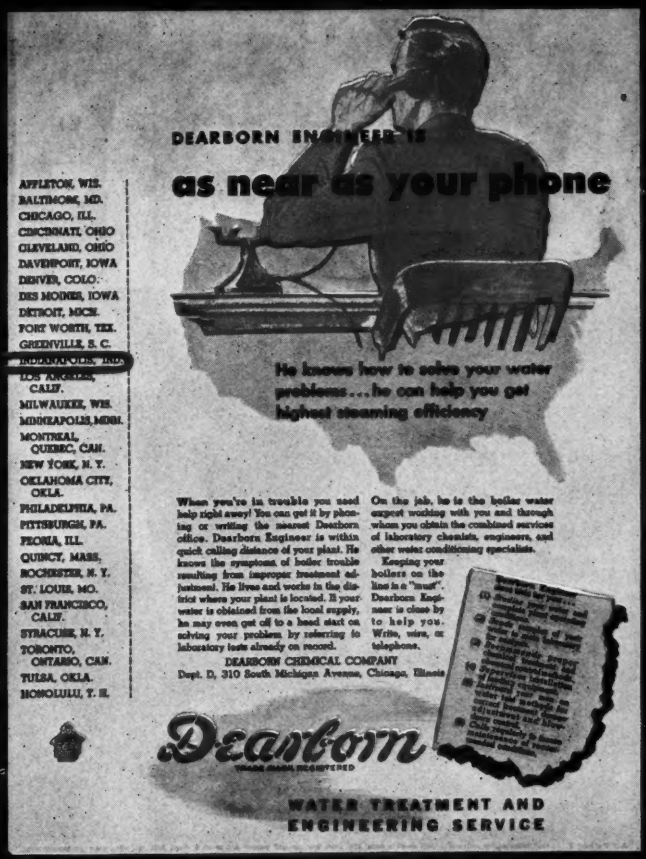
Four Vogt sectional header type boilers of 47,000 lbs. steam per hour capacity, oil fired. Design pressure 200 lbs.

HENRY VOGT MACHINE CO.
LOUISVILLE, KENTUCKY
Branch Offices: NEW YORK CLEVELAND CHICAGO PHILADELPHIA DALLAS

Vogt *Water Tube* BOILERS

BENT TUBE AND SECTIONAL HEADER TYPES

Reproduction of one of a series of Dearborn advertisements prepared to explain the completeness of field service available from nearby offices.


DEARBORN ENGINEER IS
as near as your phone
He knows how to solve your water problems... he can help you get highest steaming efficiency
APPLETON, WIS.
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CINCINNATI, OHIO
CLEVELAND, OHIO
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DETROIT, MICH.
FORT WORTH, TEX.
GREENVILLE, S. C.
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MINNEAPOLIS, MINN.
MONTREAL, QUEBEC, CAN.
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HONOLULU, T. H.
When you're in trouble you need help right away! You can get it by phoning or writing the nearest Dearborn office. Dearborn Engineer is within quick calling distance of your plant. He knows the symptoms of boiler trouble resulting from improper treatment adjustment. He lives and works in the district where your plant is located. If your water is obtained from the local supply, he may even get off to a head start on solving your problem by referring to laboratory tests already on record.
On the job, he is the boiler water expert working with you and through whom you obtain the combined services of laboratory chemists, engineers, and other water conditioning specialists.
Keeping your boilers on the line is a "must". Dearborn Engineer is close by to help you. Write, wire, or telephone.
DEARBORN CHEMICAL COMPANY
Dept. D, 310 South Michigan Avenue, Chicago, Illinois
Dearborn
TRADE MARK REGISTERED
WATER TREATMENT AND ENGINEERING SERVICE

TALKING TO DEARBORN INDIANAPOLIS OFFICE:

"You'll be here within an hour... swell... we'll be waiting for you"

● That's typical of Dearborn field service. Right now you are located within easy calling distance of a Dearborn branch office. When in trouble, lift your phone and call for help. You'll be amazed how quickly the Dearborn engineers will be in your plant to serve you.

Of course, if you're one of the thousands of power plants using Dearborn service, the periodic calls of the Dearborn Engineer keep your boilers operating at peak efficiency with minimum need for emergency service. When you have trouble, due to bad water or improperly treated water, call for the Dearborn Engineer.

DEARBORN CHEMICAL COMPANY
Dept. F, 310 S. Michigan Ave.
Chicago, Illinois

Dearborn
TRADE MARK REGISTERED

BOILER WATER TREATMENT AND SERVICE

WeldELLS

"I like the way they engineer 'em"

HE DESIGNS PIPING . . . One of the most important parts of his job is making dead sure that the strength of every part of the system is equal to the strain imposed on it.

WeldELLS and other Taylor Forge Welding fittings* are in key with this:

—They have extra reinforcement of the inner wall where stress is greatest.

—They have full pipe thickness at the outer wall.

—They have tangents that keep the weld away from the zone of greatest stress.

—They meet every condition; are made in a wider range of sizes, materials and thicknesses than any other welding fittings.

In short, they are the fitting that gives the engineer *everything* he wants—at no extra cost.

* The list of Taylor Forge's contributions to the war effort only begins with WeldELLS. Every Taylor Forge product is playing a vital part. One of many examples is Forged Steel Welding Nozzles, essential to hundreds of transports and fighting ships.

TAYLOR FORGE & PIPE WORKS
General Offices & Works:
Chicago, P. O. Box 485
New York Office: 50 Church St.
Philadelphia Office: Broad St. Station Bldg.

* WeldELLS and many other Taylor Forge products are produced in Byers Genuine Wrought Iron.

★ WeldELLS have every feature found in any welding fitting; some features found in no other fittings:

- **Seamless** — greater strength and uniformity.
- **Tangents** — keep weld away from zone of highest stress — simplify lining up.
- **Precision quarter-marked ends** — simplify layout and help insure accuracy.
- **Selective reinforcement** — provides uniform strength.
- **Permanent and complete identification marking** — saves time and eliminates errors in shop and field.
- **Wall thickness never less than specification minimum** — assures full strength and long life.
- **Machine tool beveled ends** — provides best welding surface and accurate bevel and land.
- **The most complete line of Welding Fittings and Forged Steel Flanges in the World** — insures complete service and undivided responsibility.

Simplify transformer installations with all-purpose Pyranol transformers

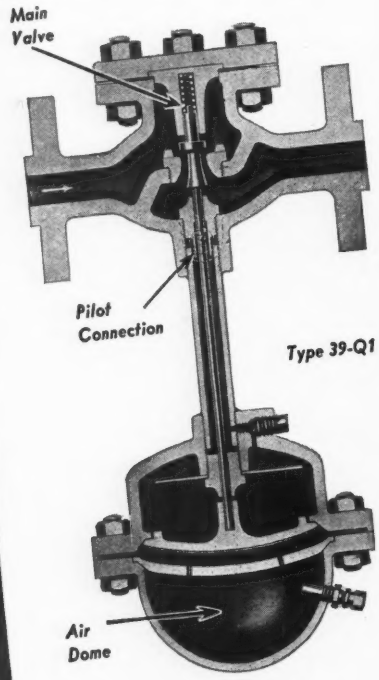
From the one fact that Pyranol* won't burn spring many benefits that would otherwise be difficult to obtain. Since you don't need expensive, fireproof vaults, you can install Pyranol transformers anywhere you wish—in the basement, on overhead beams, on the roof, or on the factory floor *at the center of the load*. Load-center distribution is highly desirable today because of the great savings in secondary copper that it makes possible. (Also, power losses are less and voltage regulation is 40 per cent better in the usual case.)

And whether the location you choose is indoors or outdoors, above ground or underground, wet or dry, clean or dusty, these *all-purpose transformers* will supply the power for your war loads with little or no maintenance.

*Pyranol is the G-E trade name for askarel, a noninflammable, nonsludging insulating liquid. Ask your G-E representative for Bulletin GES-2974—the complete story for a safer plant. General Electric, Schenectady, N. Y.

GENERAL ELECTRIC

Simple, isn't it?



The Foster 39-Q1 Pressure Reducing Regulator Gives You Accuracy . . . Easy Setting . . . Low Maintenance

Here's Why...

- Single seated for dead-end service Valve closes in direction of flow
- No springs . . . no weights
- No stuffing box . . . no packing
- Few moving parts
- Long stem . . . low heat transfer
- Large diaphragm area . . . sensitive regulation
- Easy to load or unload dome like an automobile tire

For initial steam pressures up to 2500 pounds—Delivery pressures up to 1200 pounds—Temperatures up to 1000° F.

Dome being loaded — at the valve — by hand pump.

In this latest development in pressure reducing regulators, valve action is controlled by the diaphragm of the air-loaded dome instead of the usual springs or weights. Response to slight change in differential pressure is quick because of large area of diaphragm, resulting in more accurate regulation. This regulator will handle greater reductions than have been possible, heretofore, in a single stage. Higher or lower delivery pressure is obtained by changing the pressure in the dome. It's as simple as that! There are many other types of Foster Regulators to solve your every regulation problem—and Foster engineers will gladly work with you—without obligation. Complete handbook on Reducing Valves, Temperature Regulators, Pump Governors and Sirens—with eight sections of useful engineering data will be sent if the request is made on company letterhead. Simply ask for Catalog 70.

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PRESSURE REGULATORS...RELIEF AND BACK PRESSURE VALVES...AUTOMATIC STOP AND CHECK VALVES...ALTITUDE VALVES...DAMPER REGULATORS...FAN ENGINE REGULATORS...PUMP GOVERNORS...TEMPERATURE REGULATORS...LIQUID LEVEL CONTROLLERS...FLOAT AND LEVER BALANCED VALVES...NON-RETURN AND TRIPLE DUTY VALVES...VACUUM REGULATORS OR BREAKERS...SIGHT FLOW BOXES...STRAINERS...SAFETY VALVES...SIRENS

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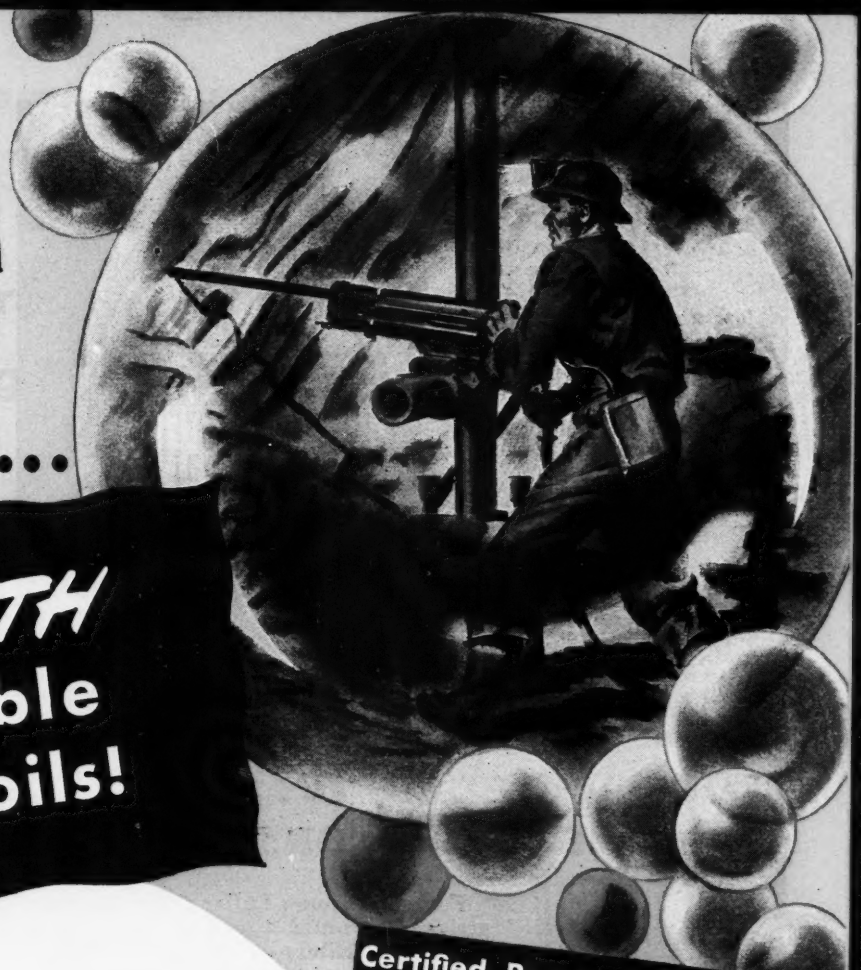
AIR is LIFE to a miner...



but DEATH to unstable turbine oils!

IT'S the tiny bubbles of air in a hard-working turbine that cause oxidation. Ever present, they kill off an unstable oil in a hurry. But even the most adverse operating conditions make little difference to Shell Turbo Oil. Check the analyses at lower right . . . there's practically no difference in the characteristics of Shell Turbo Oil, even after 19,106 hours of wartime operation.

Here you have proof, under actual operating conditions, of the superior oxidation stability of Shell Turbo Oil.

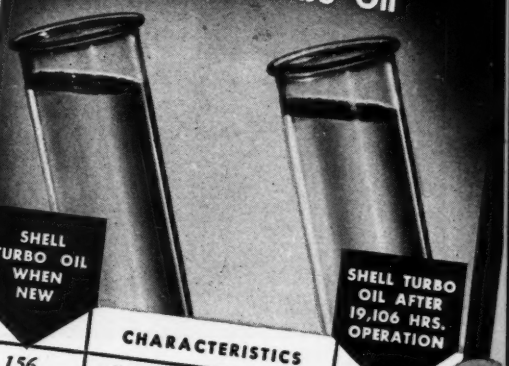
Don't chance the possibility of oxidation or rust knocking out *your* turbines. Get the complete details on this and other outstanding performances of Shell Turbo Oil from the Shell man. Or, write Shell Oil Company, Inc., Dept. "D," 50 W. 50th St., New York, N. Y., or 100 Bush St., San Francisco, Cal.

SHELL TURBO OIL

Currently, the U. S. Navy has first call on Shell's entire production of marine turbine oil

SHELL

Certified Proof of the Superior OXIDATION STABILITY of Shell Turbo Oil

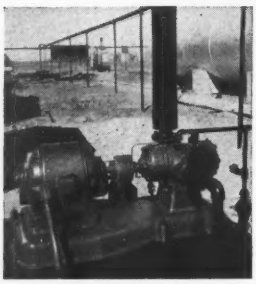


SHELL TURBO OIL WHEN NEW	CHARACTERISTICS	SHELL TURBO OIL AFTER 19,106 HRS. OPERATION
156	*Viscosity @ 100° F.*	160
Clear	*Appearance*	Clear
.05	*Neutralization No.*	.05
.1	*Saponification No.*	.1
90	*Steam Emulsion No.*	90

Performance record of Shell Turbo Oil in a unit of the OWENS-ILLINOIS GLASS COMPANY, Streator, Ill.

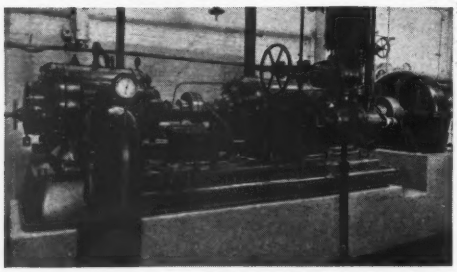
Interior of Fuller Rotary cylinder showing intake and discharge ports.

SIMPLIFIED DESIGN . . .
RUGGED CONSTRUCTION



For many years Fuller engineers have striven to build the best compressor money could buy . . . simple in design, easy to operate, ruggedly constructed for long, continuous service at minimum operating expense.

This continued effort has paid dividends, as is attested by the hundreds of machines in daily operation and the many repeat orders from satisfied customers.



Before purchasing your next compressor, get in touch with us. Send for Bulletin C-5 and become better acquainted with these modern, efficient machines.

Fuller Rotary Compressors are built for capacities to 1800 c.f.m., pressures to 125-lb. gauge. Vacuum Pumps — for vacuums to 29.90-in. (referred to 30-in. barometer).

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FULLER
PIONEERS OF HIGH-EFFICIENCY ROTARY COMPRESSORS

Power for the New Geneva Steel Mill

(*Continued from Page* 110)

rated at 14,800 gpm each, operating at 172 ft head for circulating water through the untreated water system. Three pumps, two of which are turbine driven, are rated at 23,000 gpm each, operating at 180 ft head for water circulation.

Two steam systems have been provided to cover the demands at Geneva Works: One, a 450-lb system, is closed and confined to station use only; the other, a 150-lb system, is being developed to care for the metallurgical process, heating, and miscellaneous plant uses.

All the water for condenser and boiler feed service, as well as all other points of critical heat exchange, is treated in a cold-process softening system. Condenser circulating water and water for all other plant uses of the treated water system is returned to a 312-acre reservoir, which has been constructed on the plant site for cooling and recirculating purposes.

For proper distribution and utilization of steam, water, gas, and power, a complete loading dispatching system has been designed with the necessary instruments and equipment for proper functioning. Included in this is an automatic control of power interchange between the power station at Geneva and the Utah Power and Light Co.

Engineering design on this power plant is by Sargent & Lundy, of Chicago.

The New Diesel Plant at Rushville, Ind.

(*Continued from Page* 55)

tire length. Three 480/120 v dry type transformers, each of 10 kva capacity, supply station lighting.

An outdoor substation is located adjacent to the power plant and the step-up transformers and distribution circuit breakers are located at this point. The 4160 v feeder circuits are carried underground from the plant to this substation. Two main step-up transformers are installed—each of 6000/8000 kva capacity, 4160/34,500 v. They are of the combination self and fan-cooled type.

There are a total of four outgoing 34,500 v overhead distribution circuits and three of these are connected to a 34,500 v bus by oil circuit breakers of the "DE-ION" type. The fourth circuit is connected to the bus through high-voltage fuses. Breakers are operated from the control

ONE of FOUR

Surface Condensers
Totaling 122,000 Square Feet

Typical of larger surface condensers designed and built by Lummus is this 36,000 square foot unit for a well-known public utility. Precision workmanship in the Lummus Company plant will facilitate easy and accurate assembly in the field.

All Lummus condensers are equipped with air ejectors designed and built by Lummus.

DESIGN FEATURES
LUMMUS SURFACE CONDENSERS

- Streamlined Tube Layout
- Internal Air Cooling Section
- Deaerating Hotwell

RESULTING IN —

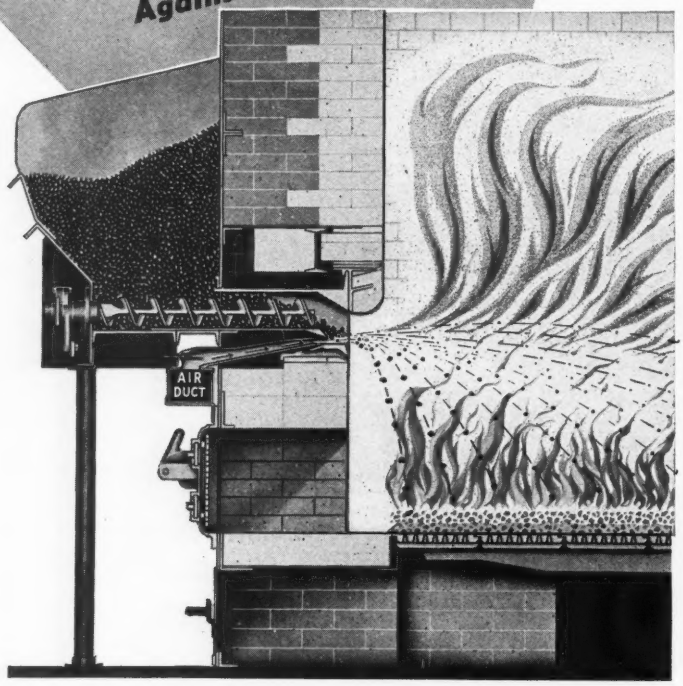
- Minimum Pressure Drop
- Minimum Condensate Depression
- Minimum Condensate Oxygen Content
- Minimum Air Ejector Steam Requirements

THE LUMMUS COMPANY · 420 LEXINGTON AVE., NEW YORK, N.Y.

LUMMUS

check these

FYR-FEEDER MULTIPLE SPREADER STOKER ADVANTAGES Against Any Stoker!



THERE is no more efficient method of coal firing than that offered by FYR-FEEDER Multiple Spreader Stokers. Check the following advantages against any other stoker and you'll know FYR-FEEDER is the stoker for you:

BURNS *ANY COAL* EFFICIENTLY . . . BURNS *WET OR DRY* COAL EQUALLY WELL . . . BURNS COAL LIKE OIL—FINES ENVELOPED IN AIR BURN IN SUSPENSION—LARGER PIECES ARE SPREAD EVENLY OVER GRATES . . . IS SIMPLE AND EASY TO MAINTAIN . . . REQUIRES NO SPECIAL SKILL OR EXPERIENCE TO OPERATE . . . IS INSTALLED EASILY IN MINIMUM TIME . . . RESPONDS INSTANTLY TO SUDDEN VARIATIONS IN LOAD . . . NO BANKING LOSSES . . . INCREASES BOILER CAPACITY . . . THIN FUEL BED ELIMINATES CLINKER FORMATIONS.

Get all the facts now, then judge for yourself. Write for catalog.

AMERICAN COAL BURNER COMPANY

ENGINEERS • ESTABLISHED 1918

Builders of thousands of Industrial Stokers

22-18 E. Erie St. **Chicago, Illinois**

board inside the plant. The high voltage bus can be sectionalized by means of a gang-operated disconnect switch maintaining the same degree of flexibility throughout the entire switchgear. Each side of this bus is connected to two outgoing circuits and the high voltage side of one of the transformers. At present only one main transformer is normally used, the other serving as a spare. Operation is with the bus sectionalizing switch closed.

All switchgear control is of the direct current type and power is received from a 120-v storage battery and charger located in the plant.

Plans and specifications for the equipment were prepared by L. H. Henley, Vice-President in charge of generation and distribution. The Burns & McDonnell Engineering Company prepared plans and specifications for modification of the building, designed the hot-air heating system, fuel-unloading facilities, plant wiring, and raw water circulating system; acted as general consultants on the project; and supervised factory and field tests of the equipment. Soil surveys were made by Robert W. Hunt & Company of Chicago. George D. Noiles is chief engineer of the plant in charge of operation and maintenance.

Keep Them Pumping

(*Continued from Page* 76)

corrosive liquid, when undisturbed, have a habit of becoming extremely hungry. If a steam pump is to be left idle for some time, provision must be made to protect the steam valve, steam cylinder walls, pistons, rings and rods from rust. It is good practice to fill the lubricator with oil, open the cock so oil can flow freely into the cylinders and let the pump make about six quick strokes to distribute the oil evenly.

When any pump has been idle for an appreciable length of time, a careful inspection is called for before starting it up. An idle machine has been known to become the repository for a misplaced wrench or handful of waste. Packing that has been in use has a tendency during prolonged shutdowns to dry out or harden. Rather than risk a scored liner, rod, sleeve or shaft, it is wise to repack the pump entirely.

Normally a centrifugal pump should be started with the discharge gate valve closed. After a pressure is built up on the dis-

Can you harness 50 H.P. with a light belt at 9000 F.P.M.?

An important commercial alcohol company had a centrifuge which was belt driven by a 50 H.P. motor. Belt speeds reached 9000 F.P.M., and no known belt lasted more than a few hours. The customer was ready to believe that belts couldn't handle the job.

Gilmer's men took a look at the job and installed an 8" Hevaloid* Belt, 126" long. Today, Gilmer Hevaloids are lasting for months... where all other belts failed in hours.

The same ingenuity which is solving belt problems all over the country, also has planned an important FREE war-time service to Industry. It's the Gilmer National Power-Recovery Plan, approved by WPB to save power in the following services: Steam, Gas, Water, Electricity, Mechanical Transmission, Boilers, Compressed Air, Refrigeration and Prime Movers. Write for your FREE copy today, and also ask for Gilmer's Handy Belt Selector... a mine of information on modern beltings.

***A WORD ABOUT GILMER'S HEVALOID BELTS:**

Hevaloid Belts are made by a patented process, exclusive with Gilmer in the United States. It is a neoprene impregnated endless cotton belting, in which latex penetrates every fibre of the cotton and stays there for the life of the belt. Lightweight Hevaloid Belts are smooth and vibrationless at high speeds, resist heat, oil, stretch and slippage... yet have shock-absorbing qualities for low-speed operation. This is an exclusive Gilmer Product.

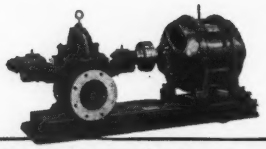
USE WHAT YOU LOSE

Gilmer BELTS

The Oldest Firm of Rubber Fabric Belt Specialists

V-Belts (F.H.P. & Multiple); Flat Belts; Round Endless Belts; High Speed Belts; Fabric Belts; Planer Belts; Special Endless Belts

L. H. GILMER CO., Tacony, Phila. 35, Pa.



Fighters on the WARREN PUMP Production Front.. No. 4 of a Series

"POP" BRINGS 30 YEARS OF SKILL TO EVERY JOB HE DOES

Chester B. Hathaway — ("Pop", to us) has had 30 years of service with Warren Steam Pump Company, Inc.
"Pop" is a vertical turret lathe operator of such skill that he can speed up with the very best of them . . . and is an artist at work which calls for close tolerances.
It is the experience, skill and conscientious effort of "Pop" and his fellow Warren employees that make it possible for Warren Pumps to be "built to fit the job," without any compromise in quality. And it is the pride that these skilled men take in Warren Pumps that enable Warren equipment to perform, so faithfully, their important job in helping to win the war.

WARREN PUMPS

WARREN STEAM PUMP COMPANY, INC.
WARREN, MASSACHUSETTS

charge, the gate valve should be opened slowly. A sudden surge of a large volume of water striking an elbow in an empty pipe has been known to cause a shock serious enough to break the piping or the pump casing. This practice is recommended particularly for large pumps.

When starting a steam pump, make sure that valves in exhaust, suction and discharge lines, and all steam end drain valves are open before opening the throttle valve. If the pump is started cold, crack the throttle valve only enough to heat the steam end thoroughly before starting. By allowing the drain valves to remain open until the pump has made a few strokes all condensation will be drained off. An appreciable amount of condensation in the steam end can cause serious damage to the steam valves.

When starting a positive displacement pump, such as a power or rotary pump, the bypass valve should always be open and then closed slowly after the pump has come up to speed. This is particularly desirable when a power pump is started against full load or when a rotary pump handling a heated fluid, such as Bunker C fuel oil, discharges into a line that may be full of oil cold enough to build up considerable resistance to a normal rate of flow.

Are Any Pumps Laboring on the Wrong Assignment?

Frequently a pump is assigned to a new job. This is particularly true today when a great many pumps are being pressed into service under operating conditions other than those for which the pumps were originally purchased. In instances, the nameplate data or the information in the manufacturer's literature is incomplete or misleading as far as the new application is concerned. Too frequently a perfectly good pump, that could have been used somewhere else, is damaged because of its misapplication to a service for which it is unsuitable.

When operating conditions change or when a pump is applied to another service, a consultation with the pump manufacturer may save an innocent victim.

Are the Manufacturer's Instructions Being Followed?

When new parts are installed or the pump dismantled, care should be exercised to make sure that everything goes back in its place, all internal nuts, bolts and

Fig. 375—Bronze Gate Valve for 200 pounds W. P. Has screwed ends, union bonnet, inside screw rising stem and a special hard bronze disc.

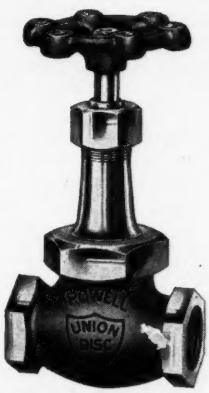


Fig. 150—Bronze "Union Disc" Globe Valve for 150 pounds W. P. Screwed ends, union bonnet, and renewable vulcanized composition disc—especially adapted for throttling service—for the control of low-pressure steam, oil, water, gas, etc.

Beginning of a long life in the POWELL Line

Before a Powell Valve earns the right to bear this time-honored name, it is called upon to prove its acceptability into an illustrious family. In blunt words, it must fill a need—actual or anticipated—before it is permitted the responsibilities of the family name.

From the moment of its conception by Powell engineers and consultants, that valve is engineered to its purpose. It must meet every requirement of "Standard of Control", which is the family motto.

This goes for *all* Powell Valves . . . of every type . . . of every proved-in-service material . . . for every need. Powell takes this special care because its near-century-old name rests upon the *pre-determined performance of every Powell Valve.*

The Wm. Powell Co.

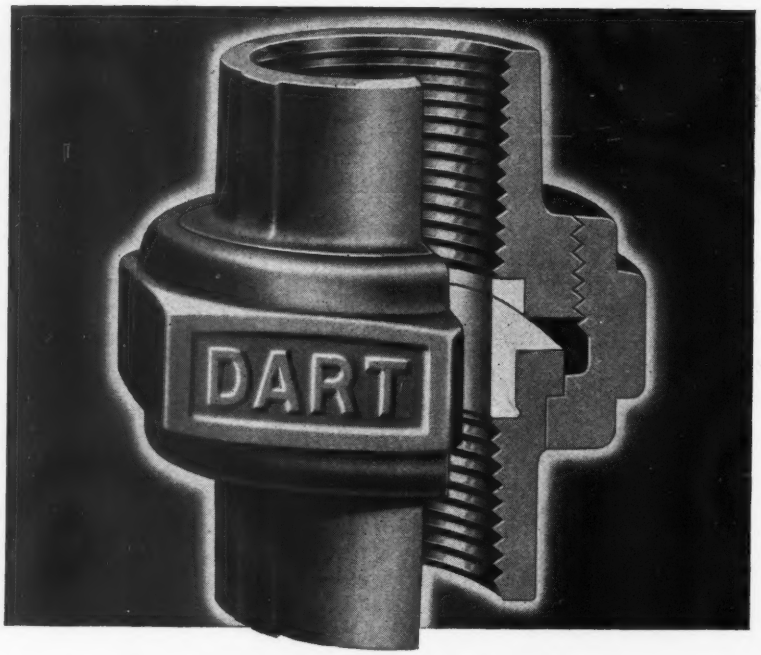
Dependable Valves Since 1846

Cincinnati, Ohio

POWELL VALVES

You Discover TREASURE

when you find Discarded Darts



...dig up your old Dart Unions and Put them Back to Work

You'll be in luck, if you can uncover some discarded Dart Unions around your plant. For a well used Dart is still a *useful* Dart . . . it can *still* give tight joint performance back on the job.

You see, Dart Unions are engineered and *made* to be used over and over again—and give complete satisfaction each time. Matched bronze seats, ground to true-ball surfaces is one reason why Dart Unions can do this. *Another* reason is that Dart bodies and nuts are made of high-test air refined malleable iron that resists pipe strains and rough handling.

So, "keep digging" . . . the rewards of finding used Dart Unions are worth the search. And if you need *new* Darts, your supplier will do his best to supply you and quickly as possible.

DART UNIONS

E. M. DART MANUFACTURING CO., PROVIDENCE, R. I.

lock nuts properly tightened and all parts free of grit or dirt. To anyone accustomed to using tools, the foregoing statements may seem unnecessary. There have been, however, many instances of extensive damage immediately after a reassembly because of a loose lock nut, a forgotten oil retainer or a misplaced lock washer. The use of a badly worn nut on the internal working parts of a pump, using an old gasket or the selection of the wrong gasket material are all trouble makers.

When a motor has been brought back from the repair shop, its rotation should be tested before it is connected to the pump. If operated in the wrong direction some centrifugal pumps will be damaged seriously by the loosening of an impeller nut or locking device. There is also the danger of injury to the pump by running it dry.

The information in instructions books furnished by pump manufacturers is based upon considerable experience with the operation of thousands of similar pumps. Time spent in reading this literature is never wasted.

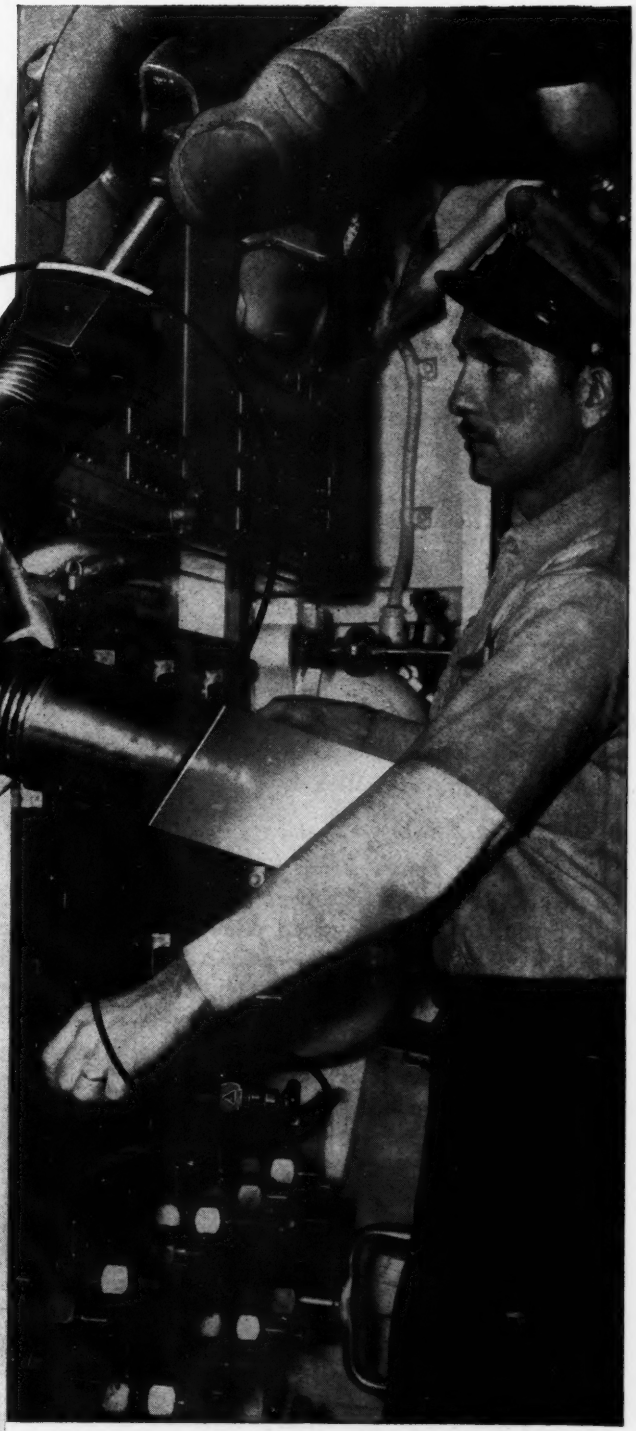
(The end.)

More New ASTM Standards Approved

SINCE MARCH 20, fourteen new specifications have been approved by Committee E-10 on Standards of the ASTM. Of these, three are emergency and eleven regular specifications. Also three emergency alternate provisions were approved to expedite procurement or conserve critical or strategic materials.

Under the activities of Committee A-1 on Steel (Pipe, Castings, Bolting) the emergency alternate provisions effective April 8 in the Standard Specifications (A 139-42) for Electric-Fusion-Welded Steel Pipe (sizes 8 in. to but not including 30 in.) were set up to permit pipe in sizes down to 4 in. in diameter to be purchased according to these specifications. It also brings the requirements on elongation values in line with changes that have been made as a regular feature in the widely used Specifications for Welded and Seamless Steel Pipe (A 53-42) and for Lap-Welded and Seamless Steel Pipe for High-Temperature Service (A 106-42T). These values are set up according to the wall thickness of the material—a detailed report appears in the 1942 ASTM Proceedings, page 95. The

Again...
THERE GO YOUR VALVES



Pig Boats

d Tin

With a crew o
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to sink twenty or
end of this war. A
men and with many
er, can count itself ex
well. The 120 to 150 men who
destroyer will be pleased if they ar
a cruiser's bag. As for the 1200 men on a
ship, their chances of doing spectacular damag
to enemy craft are governed by luck. Not more than once in one war do they expect to use their killing capacity to the limit. By the nature of his ship and machine, a submariner thus rates himself as the most efficient killer in the science of naval warfare.

By its very limitations, the submarine offers its crew opportunities to do damage to the enemy which are not given sailors on other types of vessels. Ninety per cent of the time during war our pig boats are looking for the enemy. Cruisers and destroyers, on the other hand, must often pass up the privilege of fighting in order to carry out some broad strategic objective; thus convoying, reconnaissance and scouting become a kind of boresome duty the submariner seldom knows.

Like the crews of Flying Fortresses and Liberators, pig boat men are trained hair-fine for team action. To an extent impossible to sailors on cruisers and destroyers, the security and efficiency of each one is involved with that of his fellows. No submarine skipper rates himself as more valuable than the humblest Seaman 2ndC on his ship. They are a proud lot, our pig boat men, but not boastful. They talk less of their exploits than the public likes. The brasshats apparently have decided to keep it that way. Certain critics, particularly Walter Lippman, believe the strategists in Washington have a long way to go before they will be as smart on undersea warfare as the Germans; this despite the fact that the sub is an American invention.

Maybe we aren't really smart in the way we run this branch of naval warfare, but there can be little criticism of how American subs fight. Prowling the dangerous waters of the western Pacific even to the coasts of Japan they are taking terrific toll of a wily and vicious enemy. One will get you five that when the victory score is at last compiled, the pig boats will be crowding the top.

from the April issue of "Click"

READING-PRATT & CADY

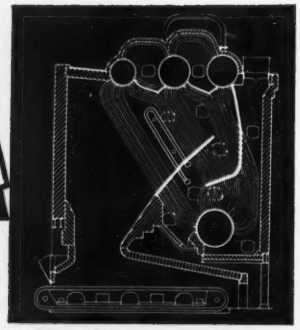
MANUFACTURERS OF
READING CAST STEEL VALVES AND FITTINGS • PRATT & CADY BRASS AND IRON VALVES
D'ESTE VALVE AND ENGINEERING SPECIALTIES

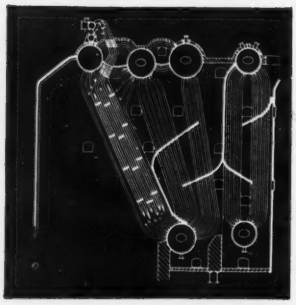
Reading, Pa., Atlanta, Boston, Chicago, Houston, Los Angeles, New York, Philadelphia, Pittsburgh, San Francisco, Portland

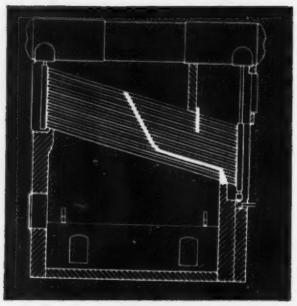
A DIVISION OF AMERICAN CHAIN & CABLE COMPANY, Inc., BRIDGEPORT, CONNECTICUT

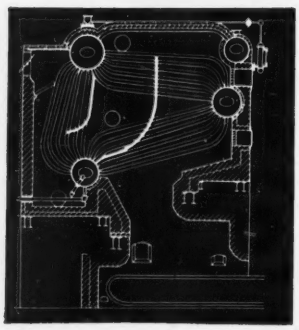
MORE STEAM

Procurable with Improved Baffles









Demands for greater boiler output are often met by installing more efficient baffles.

Overload operation need not be destructive nor cause serious outages due to furnace failures when the heat path through the boiler is well designed.

Enco baffling boosts steam output safely. The cross flow puts every foot of heating surface to work. The streamlining prevents eddy currents and dead gas pockets.

Enco baffles also cut down draft loss by doing away with bottlenecks in the passes. They save steam because soot blowers are used more effectively and less often. They can be applied to any water-tube boiler.

Each application is individually designed by men with 25 years experience in this highly specialized branch of engineering. Installations are made by skilled mechanics.

● ***A bulletin on boiler baffles gives valuable information which every engineer should have. Ask for bulletin BW 40. It's free.***

THE ENGINEER COMPANY

75 WEST STREET • NEW YORK, N. Y.

Enco Streamline Baffles

PRODUCED EXCLUSIVELY BY THE ENGINEER COMPANY

elongation in 2-in. ranges from a minimum of 35 per cent for material 5/16 in. and over in wall thickness down to 21 per cent for pipe with walls 1/16 in. thick.

Bolting Material

The new Specifications for Heat-Treated Carbon Steel Bolting Material (A 261-43T) apply to material 2 in. and under in diameter for pressure vessels, valves, flanges, and fittings, and covers material such as bars, headed bolts, screws, studs, and bolt studs. With maximum carbon on check analysis of 0.57, manganese, 1.06, minimum silicon of 0.13, the physical values are set up as follows: tensile strength, 100,000 psi; yield point, 75,000 psi; elongation in 2 in. min per cent, 16; reduction of area, 45 per cent min. Essentially the specifications are patterned after the widely used one covering Alloy-Steel Bolting Materials for High-Temperature Service from 750 to 1100 F, Metal Temperatures (A 193-40T).

Committee B-6 on Die-Cast Metals and Alloys has reviewed its specifications and established a number of emergency alternate provisions in the aluminum and zinc-base specifications.

Specifications on Refractories

Committee C-8 on Refractories has made a large number of recommendations as a result of consultations with other organizations last fall. New specifications are being put through now to prevent unnecessary delay if deferred until the ASTM Annual Meeting. Also many of these are needed for reference or incorporation in the Refractories Manual, a new edition of which is now being prepared.

Tentative Methods of Test for Sieve Analysis and Water Content of Refractory Materials (C 92-43T) include new procedures for the wet and dry methods of sieve analysis, method for determining the water content of air-dry samples as received, and for obtaining the water content of other refractory products, such as plastic refractories and wet mixes.

Tentative Specifications for Air-Setting Refractory Mortars (wet type) for Boiler Furnace and Incinerator Service (C 178-43T) cover the wet type of air-setting refractory mortars for use in laying up fireclay refractories in boiler furnaces and incinerators. Requirements are given for three classes of mortars. The temperature of the refractoriness test for each of the three classes is: Super

You Can Bank On FAIRBANKS FAIRCOSEAL Bronze Valves For Making "Silbraz" Joints

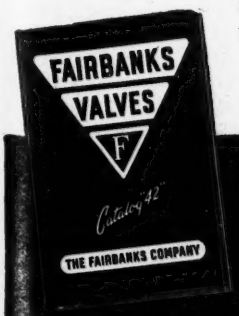
They provide protection against vibration and torsion

SERVICE: Recommended for service on steam, oil, water, brine, Freon, compressed air, acid, carbon-dioxide and gas lines for steam working pressures from 125 to 300 lbs.

TYPES: Faircoseal Bronze Valves are made in gate valves with solid wedge, non-rising stem . . . globe valves with renewable composition disc; regrinding bronze disc and integral seat; plug-type disc and renewable nickel-alloy seat and disc; regrinding nickel-alloy disc and renewable seat . . . swing check and lift-type check with bronze disc. Available in sizes from ¼" to 2".

FEATURES: Faircoseal Bronze Valves contain preinserted rings of Sil-Fos silver brazing alloy in the port openings, with which valve and pipe can be easily brazed together by applying an oxy-acetylene flame. When connected to brass, copper or copper-nickel pipe or tubing, a "Silbraz" or silver-brazed joint is formed—not a soldered joint.

It is designed to withstand as much tension compression, torsion, vibration and corrosion as the pipe with which it is connected. These joints have high tensile strength and will not pull apart at any temperature to which the valve or pipe can be safely subjected; yet they can be taken apart, if desired, by a reapplication of oxy-acetylene heat. No wicking, solder or pipe dope is needed to make a tight seal.



Write for Catalog No. 42.

OTHER FAIRBANKS VALVES

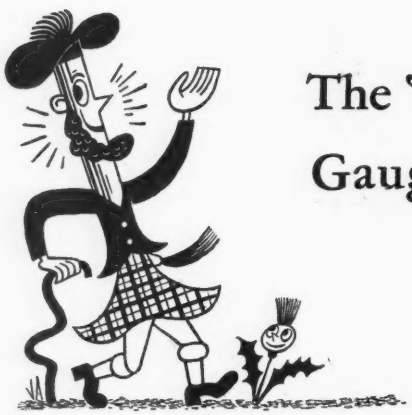
Bronze Globe, Gate, Angle Cross and Check Valves
Iron Globe, Gate, Angle, Cross and Check Valves
Faircoseal Bronze Valves
U-Bolt Gate Valves
Asbestos Packed Cocks
Bronze Radiator Valves
Sphero Ball Valves

THE FAIRBANKS COMPANY

393 LAFAYETTE ST., NEW YORK, N. Y.
BOSTON, MASS. PITTSBURGH, PA.

Distributors in Principal Cities

A reproduction from an actual unretouched color photograph which illustrates the appearance of the gauge glass from directly in front.



The "Thrifty" Gauge Glass

"That reminds me of the two Scotchmen . . ." Many a time we've heard those words, and Scotch thrift is the subject of countless jokes. Yet the dictionary says that thrift is "wisdom and care in the management of one's resources." Thrift, in other words, is just plain common sense. The real joke is on the people who *don't* demand their money's worth.

When it comes to gauge glasses, the thriftiest glass you can buy is the one that lasts longest. And the gauge glass that lasts longest is the one which best resists corrosion and has the greatest ability to withstand pressures, extreme temperature changes, and mechanical shocks—the one which avoids installation strains because of its machine drawn accuracy.

There—in a nutshell—is a description of PYREX brand Gauge Glasses. They're made of a special resistant glass, similar to that in which housewives bake, and store food in the refrigerator; similar to that used for laboratory glassware and piping in chemical plants because it resists all acids except hydrofluoric.

You don't have to be Scotch to be thrifty. And it's no trouble to use "wisdom and care" in buying the world's most economical gauge glasses. Simply tell your jobber to send PYREX Gauge Glasses—P-Y-R-E-X!

"PYREX" is a registered trade-mark and indicates manufacture by Corning Glass Works, Corning, N.Y.

CORNING Glass Works Corning, New York

Pyrex Gauge Glasses

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When writing advertisers for catalogs, descriptive bulletins or prices, please remember to say, "I saw your message in POWER PLANT ENGINEERING." Thus you'll do a good turn for the advertiser and for this publication. . . .

duty, 2910 F; high heat duty, 2730 F; intermediate heat duty 2550 F.

Other refractory specifications are: Tentative Method of Test for Combined Drying and Firing Shrinkage of Fireclay Plastic Refractories (C 179-43T); Tentative Method of Panel Test for Resistance to Thermal and Structural Spalling of Fireclay Plastic Refractories (C 180-43T); and Tentative Method of Test for Workability Index of Plastic Fireclay Refractories (C 181-43T).

The tentative revisions of the Method of Test for Pyrometric Cone Equivalent of Refractory Materials (C 24-42) give new material on size of cone and preparation of test cone.

A series of new plastic specifications of which four are nearing approval have been under development by Committee D-20 on Plastics. Other new work has been done by Electrical Insulating Materials Committee D-9 and Plastics Committee D-20, while Committee D-11 on rubber products has set up a number of emergency alternate provisions to aid in procurement and conserve rubber.

ASHVE Summer Meeting

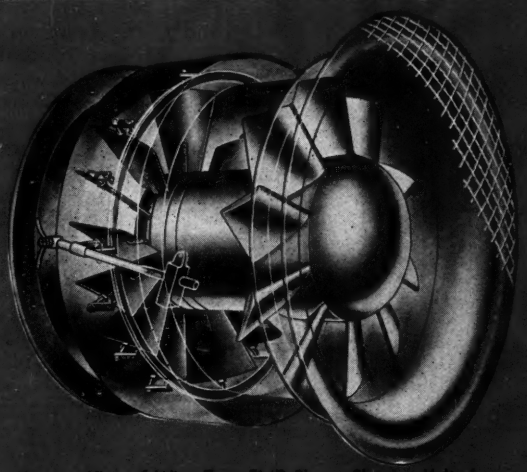
(*Continued from Page* 108)

Comfort Reactions Due to Oil Rationing

Fuel oil rationing has brought about many changes in the habits of people residing in eastern cities as was brought out by Sallye Hamilton in her report of a field study of comfort reactions of apartment dwellers undertaken during the past winter in the Hillside Homes in New York City.

The data presented included fuel oil consumption and Weather Bureau data for the test period; consumption of fuel oil, gas, and electricity; additional cost of gas and electricity, resulting from increased use of these to provide auxiliary heat; average living room air temperatures by apartments at 60 in. level, with apartment exposure and use of auxiliary heat in apartments during study; average living room air temperatures for all apartments at 30 in. and 60 in. levels for the entire study; clothing practices and adjustments to low air temperatures in apartments resulting from fuel oil rationing; and the relation of clothing and activity to varying room air temperatures.

The results show that with a two-thirds fuel oil ration it is not possible to maintain a room air temperature of 65 F in apartments

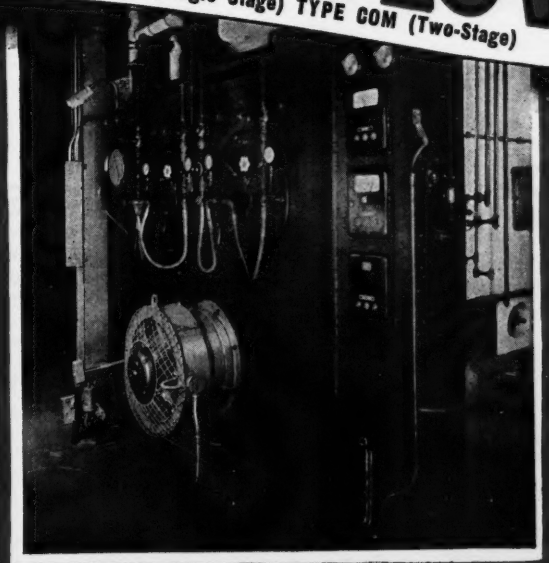


Phantom View of Wing Type EMD Blower Showing Voltrol-Vanes and Axial Flow Fan

External View of Wing Type EMD Blower from Intake End

WING AXIAL FLOW BLOWERS

TYPE EMD (Single Stage) TYPE COM (Two-Stage)



HIGH EFFICIENCY

Total Head Efficiencies Run 80% and higher

NON-OVERLOADING HP CHARACTERISTICS

●

CAPACITY REGULATION BY BUILT-IN VOLUME CONTROL

(Wing Voltrol-Vanes)

Internal radial dampers are actuated by an external balanced lever. This can be adjusted manually or connected to any standard combustion control regulation. It is precise in action and a reduction of volume is accompanied by reduction of horsepower over a wide range.

GREAT COMPACTNESS

Economy of Space and Weight

EASE OF CONTROL
QUIET OPERATION

●

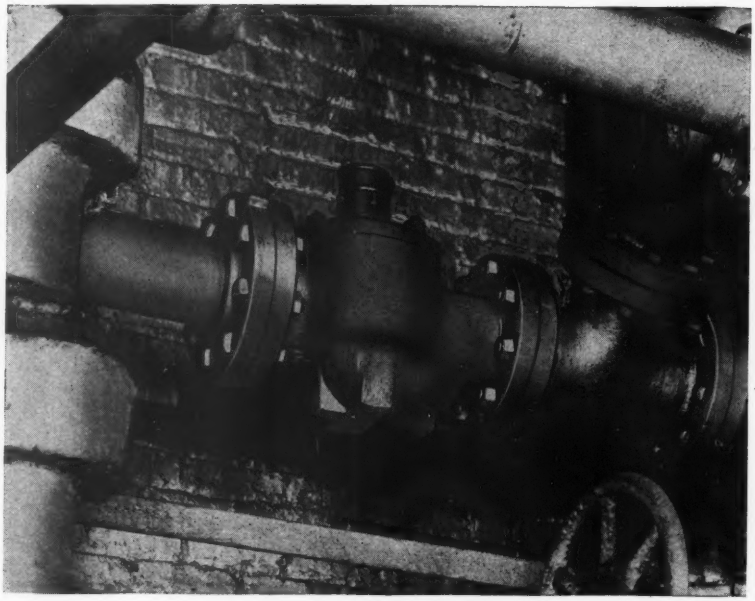
SIMPLICITY AND RELIABILITY

All mechanical features are of simple design and rugged construction. Motors are fully enclosed, dust proof, and constant speed. Fans are mounted directly on motor shafts. Entire assembly is sturdily supported inside the cylindrical casing. Heavy screen protects inlet. Discharge is flanged for ease of connection.

L. J. WING MFG. CO.

7th Ave. and W. 14th, New York, N. Y.

Factories: Newark, N. J.



Serving in WAR as in PEACE!

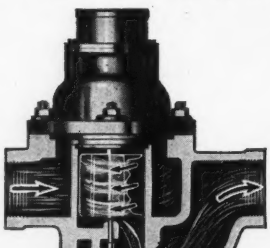
The Henszey Meter shown in action was installed to measure boiler blowdown in the power plant of a large manufacturer. Other meters had failed one after another due to the corrosive action of the hot dirty blowdown. But the Henszey Meter stood up under the conditions that were the downfall of the others.

Today—under the heavy burden of full-time war production this Henszey Meter is still on the job—putting in more hours—but still accurately measuring the blowdown.

There are hundreds of Henszey Meters serving in many war industries. They accurately measure boiler feed water, condensate, free running chemicals and other hard to measure liquids in addition to boiler blowdown. They are equally accurate at high or low flow—high or low pressures—on reciprocating or centrifugal pumps. Sizes from 10 g.p.m. to 1200 g.p.m. cold water steady flow rating. Pipe connections ¾" to 6"—special sizes to order. Calibrations can be made to read in gallons, pounds or cubic feet at any specified temperature. The meter is easily installed right in the line.

Write today for full information—please give details of your problem to save time.

HENSZEY COMPANY
Dept. C7 • Watertown, Wis.



HERE'S HOW IT WORKS

Water enters the measuring chamber tangentially, spinning in the chamber as it passes through, forming a vortex. Each gallon that passes through this chamber makes the same number of revolutions of the water. A vane is placed in the rotating water to impart this rotation to the register. A minimum of working parts without close clearances.

HENSZEY
BOILER FEED WATER
METERS

HENSZEY BLOWDOWN SYSTEMS
Boiler Feed Regulators • Flow Indicators
Proportioning Valves • Heat Exchangers

excepting the most favorable ones.

Data were presented by F. B. Rowley and C. E. Lund on their investigation of heat transmission through insulation as affected by orientation of wall to determine some of the factors that affect conductivity and to compare tests with calculated results for different applications of insulating material in framed walls and for different orientations of the wall.

As a time saver in the calculation of heat losses from one, one and a half and two story residences, Paul D. Close presented a chart by means of which rather complicated heat loss problems can be solved graphically. Ceilings, floors, walls including door and window areas, and infiltration are all accounted for in his graphic method.

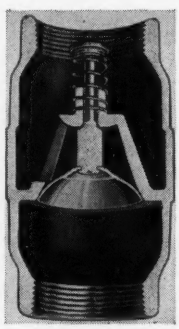
The economic factors in converting recirculated air for ventilation were discussed by H. E. Ziel and H. Sleik who stated that ventilation may be divided into the air required, on the one hand, to support physiological processes and, on the other hand, to dilute internally generated or accumulated air entrained impurities. The authors contend that the former requirements are so small that they are ordinarily supplied by unavoidable infiltration, and that economic considerations warrant the recirculation of air conditioned as to temperature, humidity, oxygen content and freed of bacteria.

NEW EQUIPMENT

Information that you desire about any equipment will be gladly furnished without obligation. WRITE POWER PLANT ENGINEERING

Strataflo Check Valve

THE WHITE MACHINE WORKS of Fort Wayne, Ind., has redesigned its Strataflo check valve by replacing the flexible rubber poppet with one made of stainless steel which retains the flexible feature but adds several advantages. It is lighter in weight; its application has been extended to use with hot



Sump Pump in Service for 25 Years Shows Superiority of Monel Rods

Installed in 1918, pump with Monel rods still gives perfect service... second pump, after failure of 3 sets of bronze rods in 10 years, now also equipped with Monel

Here's a striking demonstration of Monel's performance.

It's the record established by Monel pump rods in two pumps . . . used in the Public Library at 42nd Street, on Fifth Avenue, New York City.

Both pumps are used to clean out a sump where the drainage is exceedingly gritty and dirty. Waters used for quenching ashes (the water trickling down into the sump from the ash piles), polluted waters from ground seepage, and corrosive waters draining from the coal bins run into this sump, making a combination that is highly corroding and abrasive.

Working under these severe conditions, Monel pump rods have established a remarkable record of long, trouble-free service.

The oldest pump, installed in 1918, was equipped with Monel rods.

After 25 years, these original Monel rods are still at work, giving completely satisfactory performance. These rods have never been redressed; the only attention they receive is a repacking every couple of years with ordinary flax packing at the water end and Klinger asbestos at the steam end.

"The Monel Rods will last as long as the pump itself," is the judgment of Chief Engineer Earl I. Gates of the Library.

The second pump, installed in 1928, was equipped with bronze rods. Three sets of these bronze rods failed during the first ten years the pump was in service. When the fourth set was installed, Monel rods were used. They have now been at work for six years and are in perfect operating condition.

Veteran Monel installations such as these are now paying dividends in many ways. They conserve the time of hard-pressed maintenance and repair men. They lessen the number of expensive shutdowns. They save strategic metals by eliminating the necessity for replacements where failure of parts might otherwise have occurred.

Its combination of toughness, long life and resistance to both abrasives and corrosion makes Monel uniquely suited for uses where all of these properties are vital. For further information about Monel and other Inco Nickel Alloys, write: The International Nickel Company, Inc., 67 Wall St., New York 5, N. Y.

Monel rods on this pump at the N. Y. Public Library are still giving perfect service after 25 years.

★ ★ ★ ★ **INCO NICKEL ALLOYS** ★ ★ ★ ★

MONEL • "K" MONEL • "S" NONEL • "R" MONEL • "KR" MONEL • INCONEL • NICKEL • "Z" NICKEL

Sheet...Strip...Rod...Tubing...Wire...Castings

Safeguard
.. YOUR MEN
.. YOUR PROPERTY
.. PRODUCTION
WITH

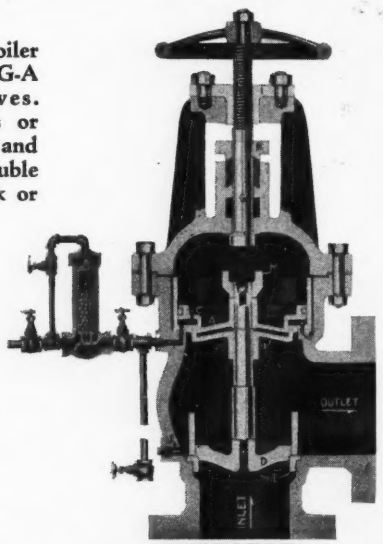
GOLDEN-ANDERSON

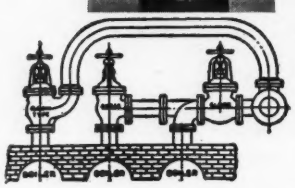
Triple-Acting ★ Non-Return

VALVES

You can make safety in your boiler plant a certainty when you use G-A Triple-acting Non-return Valves. There'll be no boiler explosions or bursting steam lines to damage life and property when you use this double cushioned valve that will not stick or chatter.

Comes with either flanged ends or welded necks, and handles 150 lbs., to 1500 lbs. Test it under pressure. It's the heaviest valve of this kind made. In angle, globe, or elbow types from 2½ in. to 16 in. in size. Free G-A catalog describing complete line will be sent to you upon request.





Also Altitude Control . . . Pressure Reducing . . . Throttle and Emergency Stop . . . Check Valves, etc. . . . . .

GOLDEN-ANDERSON VALVE SPECIALTY CO.
FULTON BUILDING • • • PITTSBURGH, PA.

water, steam, oil, gasoline and many chemicals; it may be used in any position; seating is improved by the provision of a shoulder on the stem of the valve which does not touch until pressure is exerted on the flexible poppet, this also reduces wear on the poppet and seat.

Tube Cleaner Improvements

ELLIOTT Co., Jeannette, Pa., has recently incorporated several outstanding improvements in tube cleaners designed by this company that have for their objective the reducing of outage time on important tubular equipment, greater convenience in operation, and longer life of the cleaner.

To accomplish these ends, the newer designs are made of high grade steels, improved by heat treating methods and the employment of extensive test facilities. These improvements are incorporated in a new line of motors designated as the "1300 Series." The use of these metals permits a more sturdy design of motor and a unit that gives fast and efficient heating.

Fig. 1. Elliott "1300 Series" tube cleaner

Without sacrifice of power, the new units have been so proportioned that they can be used in both straight and curved tubes. A new all-metal accessory, type FH flexible coupling, has been developed to serve as a connecting

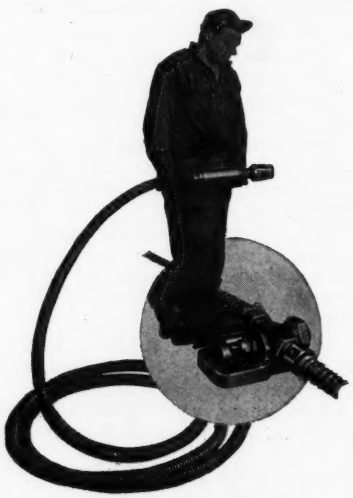
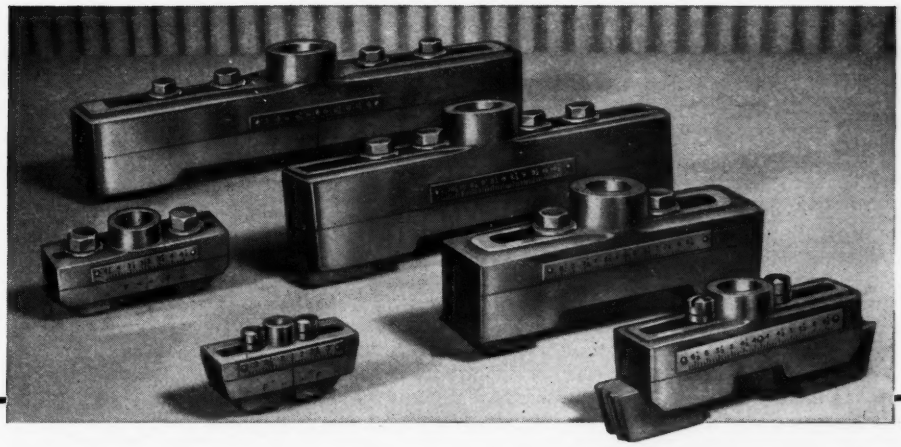


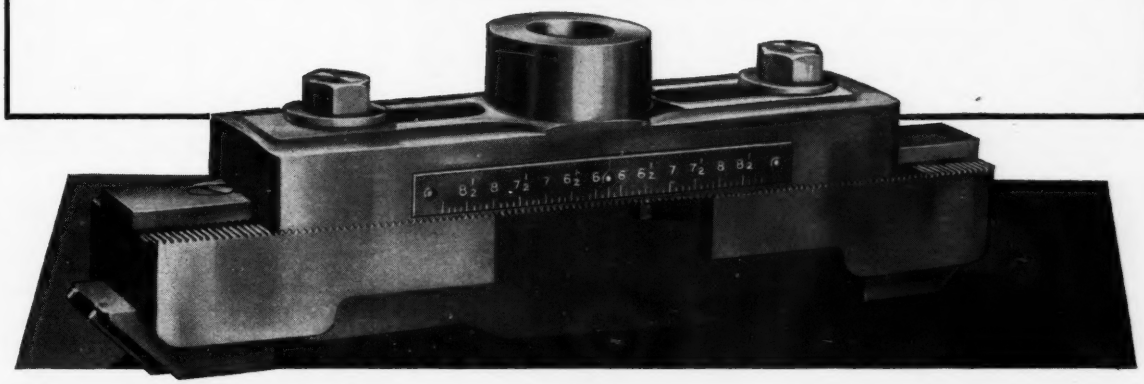
Fig. 2. Foot-operated throttle valve

piece between the main supply hose and the tube cleaner motor. It is sufficiently flexible to negotiate sharp bends and presents full cross-sectional area for the passage of air.



NEW DEXTER CUTTERS

AVAILABLE FOR ANY DEXTER VALVE RESEATING EQUIPMENT NOW IN USE



...will completely cover any seat variations
...cut any seat material

The Leavitt Machine Company announces *new-type* cutters and cutter inserts, all of which are available for any Dexter Valve Reseating Equipment now in use . . . all of which have passed tests under every type of condition.

Summed up, here are three important things to remember about this new Dexter Equipment:

(1) The adjustable cutters will adequately cover completely *all* seat variations.

(2) The interchangeable cutter inserts will handle *any* seat angles.

(3) The Tantalum Carbide Tipped inserts will cut *any* seat material.

The cutters are furnished in combinations . . . one combination for all flat seats; other combinations for 45°, 55°, and 75° angle seats. Cutters for reseating seats in 2″ valves and larger are of the adjustable type provided with interchangeable inserts for the different size valves and angles encountered. Cutters for seats in smaller than 2″ valves are covered by our multiple type suitable for reseating the seats of more than one type or size of valve.

For further information about Dexter Valve Reseating Equipment or the new Dexter Cutters write:

LEAVITT MACHINE COMPANY, Orange, Mass.

DEXTER

Valve Reseating Equipment

BRONZE BEARING BARS
AND TWO CAPABLE SUBSTITUTES

Magnolia Isotropic Bronze Bars are die-cast by an exclusive crystal control method which produces a more homogeneous structure than that of ordinary bronze bearing bars. Bearing surfaces are uniform and free of blow holes, cracks and spongy material. Magnolia Bronze wears longer than any sand cast bronze.

For those who cannot obtain priorities high enough for bronze, two capable substitutes have been developed: Defender, a tough, malleable and easily machined babbitt, and Commando, a bearing iron with manganese, copper and graphite evenly dispersed throughout the grain structure.

PHYSICAL CHARACTERISTICS

BEARING METAL	ULTIMATE STRENGTH lb per sq. in.	YIELD POINT lb. per sq. in.	ELONGATION in 2 in.	BRINELL HARDNESS
BRONZE	31,250	26,000	8.5%	70
DEFENDER	16,000	7,685	15%	19.5
COMMANDO	54,000	36,400	11%	115-120

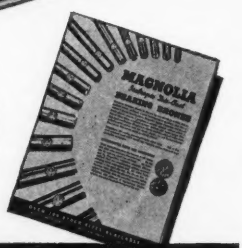
MAGNOLIA BRONZES are available in over 700 stock sizes, which include both cored and solid bars. Stock length is 13"; outside diameters range from 1" to 9". Thin walled bars and simple shoulder or flanged bushings roughed to dimensions are also available.

DEFENDER BARS are recommended for high speed, light loads, where it is desired to machine a bushing rather than pour babbitt. Not recommended for very thin sections. Solid and cored bars are available in sizes from 1" to 5" outside diameter.

COMMANDO BARS are recommended for extra heavy pressures and shock loads, also excellent for high speeds in conjunction with hardened shafts. Stock bars, both solid and cored, are available in rough sizes only from 1" to 6" outside diameter.

NEW LEAFLET

Write for copy of descriptive leaflet on Magnolia Bearing Bronze. Includes table of over 700 stock sizes available.



MAGNOLIA METAL CO. • ELIZABETH, N. J.

MAGNOLIA BEARING METALS

Another device developed for convenience in operating the cleaner is a foot-throttle valve which enables one man to clean the tubes of boilers or other heat exchange equipment without an assistant. With this valve the supply of air can be controlled between shutoff and full air pressure, or throttled to any pressure between these two extremes.

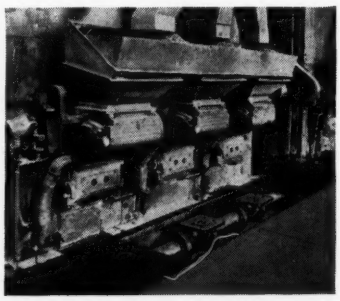
Fig. 3. The new lubricator

Lubrication of both the front and rear bearings of the motor has been improved by the development of a new automatic lubricator which sends oil directly into the tube cleaner motor through a small metallic flexible tubing placed inside the operating hose. This lubricator is connected to the air supply line through a union connection. The illustration, Fig. 3, shows the new automatic lubricator.

Ash Handling System

BEAUMONT BIRCH CO., Philadelphia, Pa., has designed a pneumatic ash handling system for boiler plants, involving the use of a minimum of critical materials. The system is particularly adaptable for installation in oil-to-coal conversion, as it requires but little change in the boiler room set-up.

This system consists of an ash conveyor pipe line, assembled from special white cast-iron pipe units, and laid in a channel in front of the ash pit doors.



Non-clogging intake hoppers to receive the ash raked from the pits are set in the line, and all ashes and dust from the boilers are drawn through the hoppers by a steam-actuated vacuum-producing unit which draws the ash through the line to an outside storage silo which is provided with discharge gate for truck or railroad car removal. Fly ash and soot lines can be led into the same ash conveyor line.

The "Vac-Veyor" system, as it is called, is flexible and is adaptable to both large and small boiler units.

● **Eliminate Air**—Cut tube end erosion by installing air and erosion eliminators. These removable screen plates, fitted with air ejection piping, remove air from circulating water before it attacks tube sheets and tube ends. Increase tube life from three to seven times in the average installation.

● **Detect Weak Tubes by Shock Test**—The 10-year-old hydro-dynamic Shock Test destroys tubes just ready to fail. Frequently, less than ten percent of the tubes in large condensers require replacement, but, unless discovered and removed, they will soon necessitate another shut-down and even major overhaul. Only by Shock Test can you mechanically and accurately distinguish good tubes from bad.

● **Stop Tube End Wear**—Use FLOWRITES, replaceable, bell-mouthed sleeves at entrance ends of either new or old tubes. They provide smooth, directed flow of circulating water, eliminating air pockets and preventing air caused erosion of tube ends and pinholes.

● **Stop Tube Leaks—Fast**—The WIZARD Injector and Special Sealing Compound will stop tube leaks in a few seconds.

✔ **Don't Scrap Tubes with Worn Ends**—Even tubes with ends worn through can be salvaged. If they withstand the Shock Test, we can stretch them to usable lengths, cut off the bad ends and return them to service.

* * *

In holding down condenser maintenance costs, the Big League Utilities have kept our facilities and our field crews busy for seventeen years. Today, uninterrupted flow of power for war production is more essential than ever.

Avoid breakdowns and priority holdups by taking advantage of Conseco nation-wide, clock-around service. A letter, telegram or 'phone call will start your job rolling. Estimates furnished for specific work.

Condenser Service
AND ENGINEERING CO., INC.

83 RIVER STREET, HOBOKEN, NEW JERSEY

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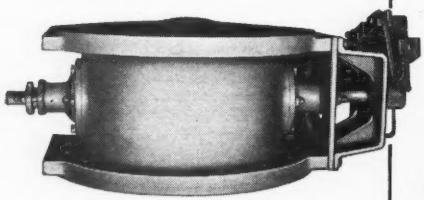
NEW JERSEY TELEPHONE—HOBOKEN 3-4425

NEW YORK TELEPHONE—RECTOR 2-9360 **AFTER 6 P. M. AND SUNDAYS—HOBOKEN 3-4428**

There's an R-S DISTRIBUTOR As Near as Your Telephone

Above: 15-lb Wafer Type (Narrow face-to-face construction). *Below:* 125-lb valve equipped with control cylinder. Double end stuffing box eliminates end thrust.



These R-S Distributors are valve specialists. They are experienced with the solution of problems encountered in the control and shut-off of air, gas, steam, liquids and semi-solids. Familiar as they are with the application of valves to high and low pressures, temperatures and volumes, they can frequently make suggestions that will simplify a valve installation and reduce costs.

Naturally, these local representatives are thoroughly familiar with the R-S development of special metals for resistance against heat, abrasion and corrosion.

Get acquainted. These valve experts are good men to know well.

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R-S QUALITY PRODUCTS SINCE 1908

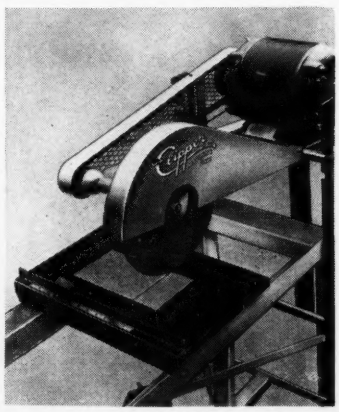
15 to 900 psi

VALVE DIVISION
R-S PRODUCTS CORPORATION
4535 Germantown Avenue • Philadelphia, Pa.

R-S Streamlined BUTTERFLY VALVES

Masonry Saw

CLIPPER MANUFACTURING CO., Suite 5, Chouteau Bldg., St. Louis, Mo., has developed a circular saw blade made



of abrasive material particularly suitable for cutting refractory blocks, leaving the cut edge smooth and in perfect condition for making tight joints so desirable in furnace walls.

These saws are motor driven and for industrial use are mounted on a steel frame making the whole unit readily portable. The various elements of the unit are easily adjustable to meet size requirements of the brick and a conveyor cart with measuring gage operated on ball bearings gives the operator positive control of cutting at all times and insures close precision. Sizes vary from blades 12 in. in diameter to 18 in. driven by motors from ¾ to 1½ hp, and models are available for gasoline engine drive.

Cleaner For Small Tubes

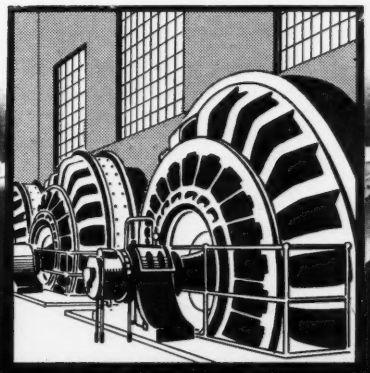
DEVELOPMENT of an entirely new and revolutionary type of tube cleaner has been announced by Thomas C. Wilson, Inc., Long Island City, N. Y. The new tube cleaner was especially designed to clean the small diameter tubes (⅜ to 1¼ in. I. D.) used in condensers, heat exchangers, and similar apparatus.

The new tube cleaner operates at high speed and uses a cutter-bit which does not tend to clog or jam so as to damage or break either the shaft or the cutter-bit itself.

In conjunction with the development of the new tube cleaner, an attachment has been designed which gives to the cutter-bit the combined movement of a rotary tube cleaner and a percussion hammer, and greatly improves its effectiveness in breaking up hard deposit. The attachment is operated by the air or steam used as the scavenging agent in the tube cleaner.

Tri-Clad Motors

A NEW ADDITION to its line of Tri-Clad motors is announced by the Motor Division of General Electric Co., Schenectady, N. Y. These new motors are



POWER PLANTS ARE DESIGNED.. *not just Built!*

The power industry has accomplished the impossible... a fifty per cent increase in output over 1940.

Technical design and sound planning met the challenge of Pearl Harbor—to out-produce our enemies who had a seven-year head start. Industry demanded power—more and more power—they got it, to the tune of 65 million "horses."

Behind this unparalleled increase in power capacity is the aggressive engineering of men who recognized their responsibilities—men who knew power plants must be designed—*not just built.* Whether it is electricity, steam, diesel, hydraulic or natural gas, Pritchard Power Engineers are thoroughly capable of designing and constructing the plant best adapted for the power to be used. J. F. PRITCHARD & COMPANY—*Power Division*—Fidelity Building, Kansas City, Missouri.

KANSAS CITY
TULSA
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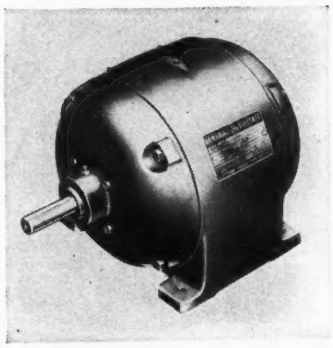
ENGINEERS AND CONSTRUCTORS
FOR THE CHEMICAL • PETROLEUM • GAS AND POWER INDUSTRIES
Manufacturers of Mechanical and Atmospheric Cooling Towers

available in both the polyphase, 60-cycle, induction type and the single-phase, 60-cycle, capacitor type and are especially designed for use under conditions where abrasives, chemicals, rain, snow and excessive dirt are encountered.

These new motors are totally enclosed and have all the important basic features of the Tri-Clad group, including triple protection, protection against physical damage, electrical breakdown and normal operating wear and tear. All parts of the motor enclosures are cast iron, thus providing exceptional resistance to rust, corrosion, accidental blows and rough use. The leads are permanently encased in compound in a cast-in pocket in the stator frame which



prevents liquids from seeping into the motor. The motors are wound with Formex wire.

The polyphase motors are furnished in frame sizes 203 to 225. They include ½, ¾, and 1 hp at 900 rpm; ¾, 1, and 1½ hp at 1200 rpm; 1, 1½, and 2 hp at 1800 rpm; and 1½ and 2 hp at 3600 rpm. The single-phase motors are furnished in frame sizes 203 and 204, and include ¾ hp at 1200 rpm; 1 and 1½ hp at 1800 rpm; and 1½ and 2 hp at 3600 rpm. The mounting dimensions of these motors are interchangeable with Tri-Clad open motors of the same rating.

"TAILOR-MADE" FIREBRICK
This New Circular Tells How
Shorter lengths, and special angles can all be made quickly and accurately on your job from virtually any firebrick.
Clipper Masonry Saws are rapidly gaining popularity with power plants because of their ability to speed repairs and lessen "Down Time."
You can easily and economically cut Clay—Chrome — Silica — Magnesite — Sillimanite and Acid Brick.
Get this latest information by writing . . . today.
CLIPPER MFG. COMPANY
Suite 4, Chouteau Building
St. Louis, Missouri

Non-metallic Pipe

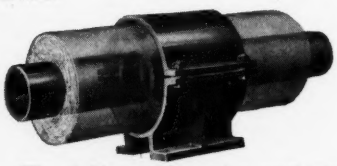
DEVELOPMENT of a new line of non-metallic drain and sewer pipe, requiring no critical war materials, to replace dwindling supplies of metal pipe has been announced by the Fibre Conduit Co. of Orangeburg, N. Y.

The fibre pipe—made of cellulose fibre impregnated with coal tar pitch—is said to be not only a satisfactory replacement but in many cases an improvement over metal and tile pipe for drains and sewers as well as for industrial, home and farm uses wherever pressure is not high.

The new non-metallic pipe is resistant to moisture, tuberculation, root growth, corrosion and most dilute inorganic acids and alkalies, it is claimed, and durable, light, installed easily and cut to desired lengths with an ordinary wood-working saw. Couplings maintain pipe lengths in line and provide tight joints if desired.

Pipe Alignment Guide

AMERICAN DISTRICT STEAM CO., North Tonawanda, N. Y., recently announced the new ADSCO pipe alignment guide, Model G, which is an improved product, redesigned to save critical metal and machining operations. It is used on steam, hot water, fuel oil or other pipe lines adjacent to expansion joints to insure true alignment of pipes in service.



The guide consists of a semi-steel spider and guiding cylinder, allowing for a pipe movement of 8 in. To install, the lower half of the guiding cylinder is bolted into place, the two piece spider is bolted to the pipe and the pipe is then insulated and the upper half of the cylinder bolted to the base section. In service, the four fingers of the spider ride on the inside of the cylinder, which is coated with heavy grease before shipment, to provide true pipe alignment.

New High Speed Gas Engine

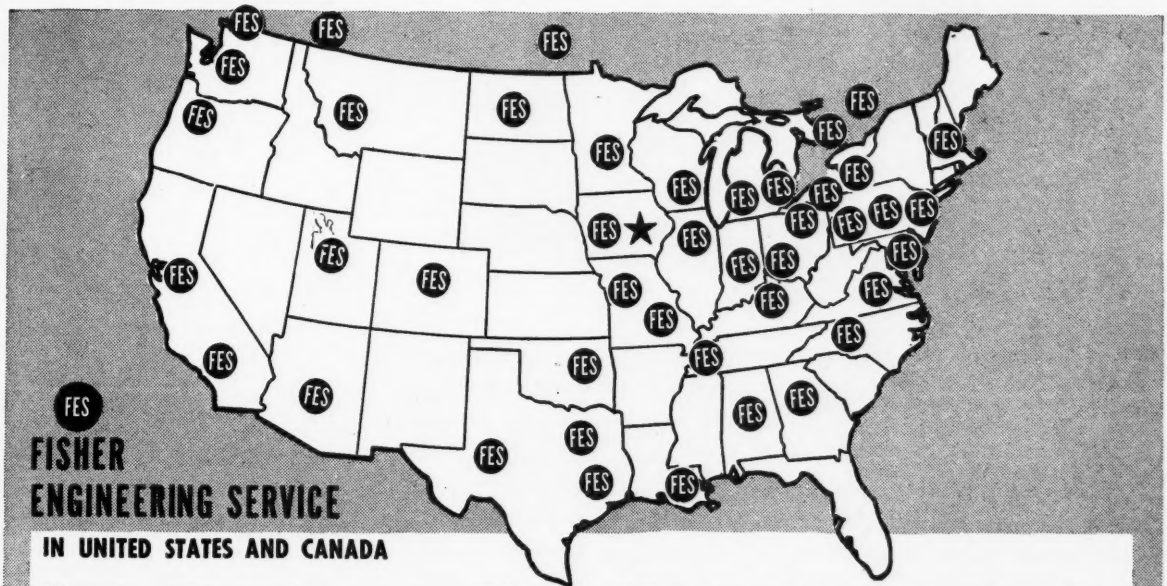
THE NEW V-12 BLUE STREAK Engine is announced by Climax Engineering Co., Clinton, Iowa.

With a normal speed range of 600 to 1200 r.p.m. and a brake horsepower of 435, the new V-12 is designed to meet today's demands for a high-speed engine which will mesh with modern power consuming machinery for rock or oil drilling, operating large pumps and compressors, driving mining and construc-

WELL MANNED FISHER SERVICE FRONTS

Adequately Maintained To Serve Your Needs!

Fisher Governor Company's nation-wide ENGINEERING SERVICE has been maintained at full strength during this emergency because we appreciate the present need for best possible pressure and flow control, and the equally important responsibility of maintaining existing control equipment at peak efficiency. Forty-three Fisher representatives, strategically located throughout the United States and Canada have more than 150 thoroughly trained and experienced control engineers ready to serve you



IN UNITED STATES AND CANADA

Atlanta, Ga. — Rittelmeyer & Company
Baltimore, Md. — E. A. Rhodes
Battle Creek, Mich. — DuBois-Webb Co.
Birmingham, Ala. — Eshelman & Potter
Bismarck, North Dakota — Lignite Combustion Engineering Corp.
Buffalo, N. Y. — W. J. Sommers
Butte, Montana — Sullivan Valve & Engineering Co.
Calgary, Alberta — Barber Engineering & Supply Co.
Cambridge, Mass. — L. C. Price & Co.
Charlotte, N. Carolina — Robert E. Mason
Chicago, Illinois — General Meters & Controls Co.
Cincinnati, Ohio — Harry T. Porter
Cleveland, Ohio — Tomlinson Steam Specialty Co.
Dallas, Texas — Vinson Supply Co.
Denver, Colorado — Joy and Cox, Inc.
Des Moines, Iowa — Midwest Controls Co.
Detroit, Mich. — DuBois - Webb Company
Houston, Texas — M. N. Dannenbaum Co.
Indianapolis, Indiana — Acme Engineering Agency
Los Angeles, Calif. — Fisher Governor Co.
Louisville, Kentucky — John Zimmerman
Memphis, Tennessee — C. J. Gaskell
Milwaukee, Wis. — Steam Plant Equipment Co.
Minneapolis, Minnesota — E. Floyd Bell
Montreal, Quebec — Mechanical Equipment Co.
New Orleans, La. — John H. Carter Co.
New York City, N. Y. — King & Shepherd
North Kansas City, Missouri — Uhrich Supply Co.
Odessa, Texas — Vinson Supply Co.
Philadelphia, Penn — Sheffler-Gross Co.
Phoenix, Ariz. — George S. Thompson Co.
Pittsburgh, Penn. — W. A. Stoeltzing
Portland, Ore. — Harris Supply Company
Richmond, Virginia — John Fensom Co.
Rochester, N. Y. — Ralph C. Schwarz
Salt Lake City, Utah — Williams & Richardson
San Francisco, Calif. — George E. Swett & Company
Seattle, Washington — Chas. J. Yost
St. Louis, Mo. — Weeks Engineering Co.
Toronto, Ontario — Fred Carruthers
Tulsa, Oklahoma — Vinson Supply Co.
Vancouver, B. C. — Fleck Bros. Ltd.
Winnipeg, Manitoba — Power & Mine Supply Co.

IN OTHER COUNTRIES

Manchester, England
Havana, Cuba
Honolulu, Hawaii
San Juan, Puerto Rico
Buenos Aires, Argentina, S. A.
Mexico, D. F.

When you need help to put Fisher Controls into service . . . need the answer to control valve troubles . . . suggestions for possible changes in existing equipment that will effect greater control efficiency . . . recommendations for new controls to solve your particular problems . . . CALL FOR FISHER ENGINEERING SERVICE from your nearest Fisher Representative.

While the Fisher Service Fronts are still well manned — with but few men lost to the armed services, the demand on the time of these Service Engineers is extremely great. Call on them whenever you are in trouble or need help, but we ask your co-operation in avoiding unnecessary calls. Their time is valuable to the war program.

FISHER GOVERNOR CO.
MARSHALLTOWN, IOWA

A MASTERPIECE
in steel construction
FOR HIGH PRESSURES . . .
FOR HIGH TEMPERATURES

THIS Super-Silvertop Steam Trap for high pressures and temperatures is a masterpiece in steel construction. Its valve and seat are of special chrome nickel alloy, internal parts are of stainless steel. It is so complete that it can be installed without buying any extra, expensive fittings; without bending any pipe, or installing or making up extra pipe joints. Connections are in the top so that it can be installed straight-in-line as shown above, or used as an elbow—in either case only two threaded joints are required. Its gasket joint is recessed to prevent blow-outs. The book "How To Choose a Steam Trap" gives complete details. Send for it today.

THE V. D. ANDERSON CO.
1939 W. 96th St., Cleveland, Ohio

Super-Silvertop
STEAM TRAPS

BEARINGS NEW AND USED

100,000 Sizes and Styles

We BUY and SELL bearings of all types, sizes and styles. Send specifications of your requirements for our low prices.
Liberal cash paid for your old or surplus bearings.

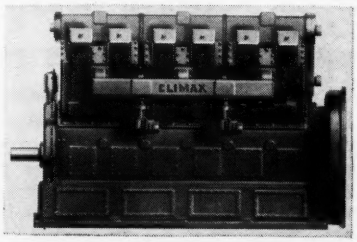
CARBIDE CUTTING TOOLS

Standard and special sizes at lowest prices.
Send your specifications.

NEERUP INDUSTRIAL EQUIPMENT
2310 Cottage Grove Ave. CHICAGO

tion machinery and, with suitable generators, for generating electric power.

The engine is designed for wide fuel range, to burn natural gas, butane, gasoline or other fuels. Change-over is made



with standard, outside located accessories. Dual carburetion is provided for complete and uniform fuel distribution, full power and low fuel consumption. Each cylinder has two spark plugs to provide a greater flame, increase power output and obviate ignition failure.

The Climax new V-12 is available in two bores. Model V-335, 6½-in. bore and 7-in. stroke develops 375 hp. at 1200 r.p.m. Model V-390 with a 7-in. bore and 7-in. stroke develops 435 hp. at 1200 r.p.m.

Dual battery and magneto ignition can be furnished in any combination.

Where required, Climax will furnish a complete range of accessory equipment.

OBITUARIES

H. F. T. Erben

H. F. T. ERBEN, former manager of the General Electric Schenectady works and member of a well-known navy family in whose honor a destroyer was named when launched in Maine last March, died in Ellis hospital at Schenectady, April 8. He was 77.

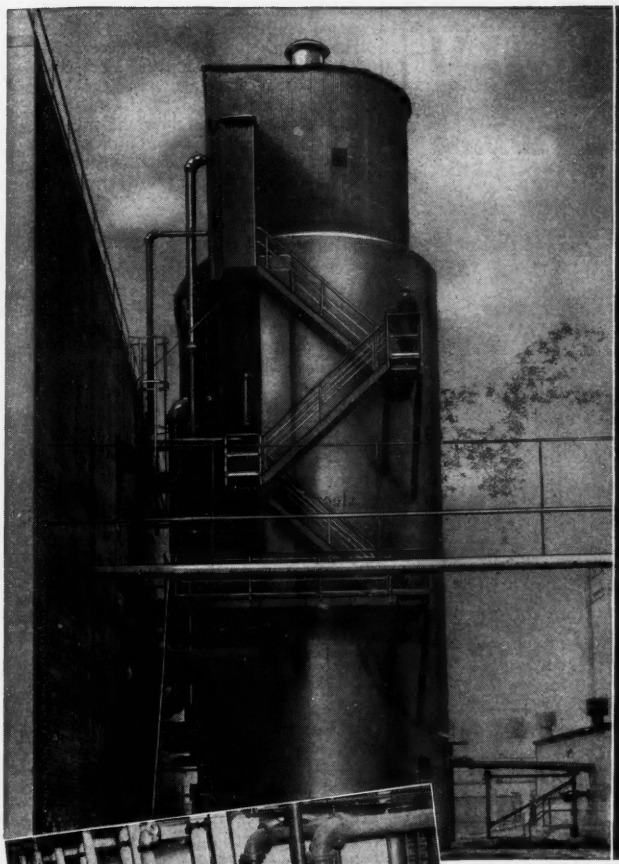
In 1887, following graduation from Stevens Institute of Technology, Mr. Erben entered the employ of the Edison Machine Works in Schenectady, forerunner of General Electric. Born in New York City in 1866, he spent most of his life in Schenectady.

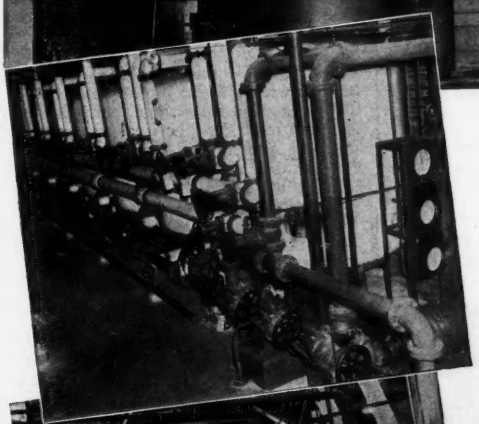
He was designing engineer of General Electric's direct-current department, and in 1914 became engineer of the Schenectady works, being promoted two years later to assistant works manager. General Electric had pioneered in the field of electric drive for warships, and during World War I the manufacture of turbines and other naval propulsion equipment formed an important part of the Schenectady plant's war production. Mr. Erben became works manager in 1920 and four years later was named assistant to the vice president attached to the general manufacturing department. He retired in 1928.

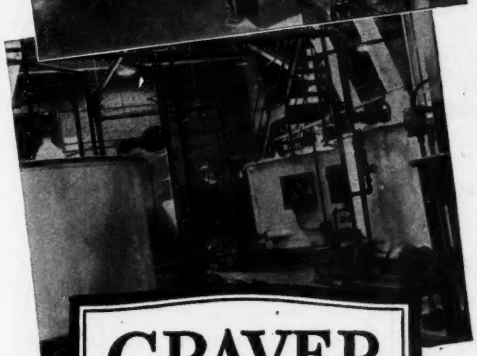
Mr. Erben was the son of Henry Erben, who fought with Farragut in the Gulf of Mexico during the Civil War and, as a rear admiral, retired, returned to serve in the Spanish-American War. On March 21 of this year the destroyer Erben, named for the admiral, was launched in the Kennebec River.

R. H. Chadwick

R. H. CHADWICK, assistant to the manager in charge of engineering at the Fort Wayne Works of General Electric Co., died May 29. He was 51 years old. Mr. Chadwick was born in Gardiner,







Designed-Built-Installed by GRAVER

This Graver Hot Process Water Softener and Deaerator is one of two Graver built units, each with a capacity of 60,000 gallons per hour, now serving one of the nation's large ordnance plants. In addition to the Softening and Deaerating unit, the equipment includes six Graver Water Filters, chemical feeders, and a sedimentation tank.

Here is another example of Graver's complete service. The entire equipment was designed by Graver engineers in accordance with specifications of the consulting engineer, built in the Graver East Chicago Plant, and installed by Graver workmen under Graver supervision.

From laboratory analysis to working unit, Graver does the whole job.

Whatever your water conditioning problem may be—consult Graver. There's no obligation.

GRAVER

GRAVER TANK & MFG. CO., INC.

4809-85 Tod Avenue, East Chicago, Ind.

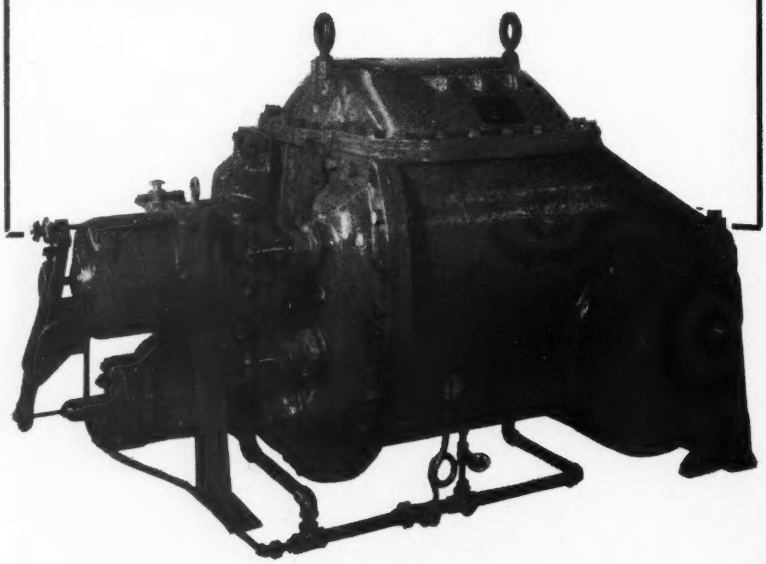
NEW YORK • CATASAUQUA, PA. • CHICAGO • TULSA

Water Conditioning Equipment

43-32-W

MURRAY TYPE UV

Multi-stage Mechanical Drive Turbine

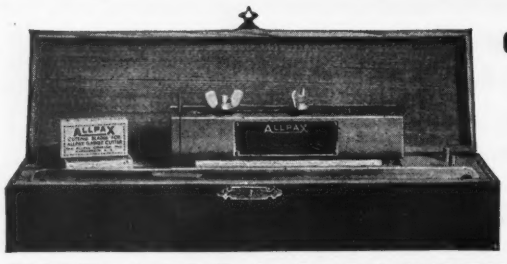


The Murray "UV" Multi-stage Turbine parallels the design of the Type "U" Single Stage Turbine. It has the same unique and patented arrangement of the casing which is split horizontally well above the shaft center line. This construction provides a longer steam ring with greater nozzle area and larger steam inlet size, larger exhaust opening, additional hand valves and improved efficiency.

View shows the unit equipped with mechanical shaft type main speed governor and hand speed changer. Also shown is the standard center line exhaust end support and flexible steam end support.

The "UV" turbine can also be provided with oil relay governor—either of the constant or variable speed type; as well as extraction or extraction mixed pressure gear. Write for descriptive bulletin.

MURRAY
IRON WORKS COMPANY
INCORPORATED 1870
BURLINGTON IOWA



Cuts your gasket costs in half

The most remarkable tool ever invented

Write for booklet

THE ALLPAX GASKET CUTTER

Manufactured by

THE ALLPAX COMPANY, INC.

Distributors everywhere ***Mamaroneck, N. Y.***

Maine, and graduated from Brown University with the degree of B.S. in electrical engineering. In 1912 he enrolled in the Test Course at the Fort Wayne Works and later entered the Transformer Engineering Department. In 1926 he was appointed engineer of the Transformer Department and continued in that capacity until April, 1941, when he was made assistant to the manager in charge of engineering.

Ludwig Kallir

LUDWIG KALLIR, retired chairman of the board of directors and chief engineer of the A.E.G. Union Electric and Manufacturing Co., Vienna, Austria, died on January 7, 1943, in a London, England, hospital. He was 68 years old. Mr. Kallir had been prominently identified with power generation, transmission and distribution in Central Europe for more than forty years. He was a member of the committee of action of the International Electrical Commission and the chairman of the committee for standard specifications of the Austrian Institute of Electrical Engineers.

He represented his country at many international conferences as an official delegate; as such he spent some time in this country during the 1936 World Power Conference. Best known among his many papers and articles in the technical press and in the transactions of engineering societies was his contribution on "Power Transmission" in the well-known European handbook on electrical power edited by Rziha and Seidener.

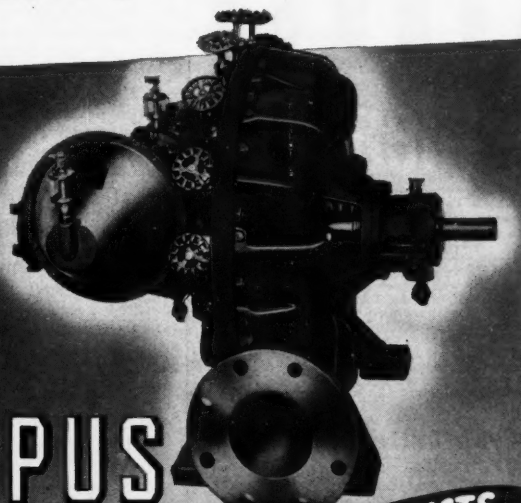
Born in Austria in 1874, he received his engineering education at the Vienna Institute of Technology, was graduated in 1896 with highest honors, and stayed there for the following four years as an instructor in electrical engineering until he joined the Union Electric & Mfg. Co., Vienna, which was later bought by the A E G Berlin and became, as its Austrian branch the A.E.G. Union Electric & Mfg. Co. In 1908 he was made head of the central station engineering department, later became a member of the board of directors, finally its chairman and chief engineer of the company.

He retired in 1937 and kept on in Vienna in a consulting capacity until German influence began to overrule first the economic and then the political life of his native country. However, there was no place for a man of his kind after the annexation of Austria and he went to England in 1939, where the British Electrical and Allied Industries Research Association, London, gave him an opportunity to keep on in his lifelong devotion to electrical engineering.

MANUFACTURERS' PERSONALS

George Johnstone, Jr., formerly assistant foundry superintendent at the Grove City, Pa. plant of The Cooper-Bessemer Corp., has been promoted to foundry superintendent. Mr. Johnstone received his foundry and metallurgical education at Temple University and Carnegie Institute of Technology and before joining Cooper-Bessemer was foundry superintendent for William A. Hardy & Sons Co. of Fitchburg, Mass.

It's just horse sense that a "horsepower" Steam Turbine sized right for the job saves metal for war and money for you while an "Elephant Power" Turbine too big for the job wastes both. COPPUS Blue Ribbon Turbines come in six frame sizes from 150 H. P. down to fractional. Each smaller size requires less metal and is priced less. The "Blue Ribbon" certifies prize-winning COPPUS performance.



COPPUS TURBINES

Save Metal in Wartime — Will Save You Money in Peacetime

Like all Coppus "Blue Ribbon" Products (blowers, ventilators, gas burners, etc.), the Coppus steam turbine is a precision-made product . . . controlled by Johansson size blocks . . . and every turbine is dynamometer-tested before shipment. More than 85% of all orders since 1937 have been repeat orders.

Write for Bulletin 135-9

COPPUS ENGINEERING CORPORATION
337 Park Avenue, Worcester, Mass.

Sales Offices in THOMAS' REGISTER
Other "Blue Ribbon" Products in
SWEETS and CHEMICAL ENGINEERING CATALOG

COPPUS

BLUE RIBBON PRODUCTS

DESIGNED FOR YOUR INDUSTRY . . . ENGINEERED FOR YOU

Here's POWER to Clean Tubes FASTER with Less Labor

A single operator can now clean tubes by himself by using a Roto Tube Cleaner equipped with an air valve. This not only releases a helper for other work around the plant, but actually enables the operator to clean tubes more efficiently. By controlling the entire operation of the cleaner, the operator doesn't have to waste time signalling a remote helper to turn air off and on between every tube cleaned. This exclusive Roto time- and labor-saving feature, plus the well-known power and cleaning efficiency of Roto Tube Cleaners, help solve many pressing problems during the present emergency. Write us today.

The **ROTO** Company

145 Sussex Avenue, Newark, N. J.

ROTO Tube Cleaners

CLASSIFIED ADVERTISING

POSITION WANTED

POWER PLANT ENGINEER—Available—Now Employed—Qualified by experience and Training to Assume Complete Responsibility of Operating Municipal Utility or Industrial Power System—Permanent Position. Address Box 1425, Power Plant Engineering, 53 W. Jackson Blvd., Chicago 4, Ill.

MECHANICAL ENGINEER, Aged 46, Native American, eighteen years steam electric, hydroelectric plant, eleven years in present position, in full charge of power production, desires change. Prefers Puget Sound area but would consider others. Fitted by training and experience for employment as superintendent, chief engineer, or maintenance engineer of public utilities or industrial plant. Address Box 1424, Power Plant Engineering, 53 W. Jackson Blvd., Chicago 4, Ill.

HELP WANTED

Mechanical Engineer or Draftsman capable of designing cast steel and cast iron valves for industrial service. This is an opportunity to join the Engineering Staff of an old established Eastern New York State Valve Manufacturing Company. Applicants without actual valve design experience will not be considered. In reply state experience, age and salary required. Address Box No. 1422, Power Plant Engineering, 53 W. Jackson Blvd., Chicago 4, Ill.

OPPORTUNITIES OFFERED

SALES ENGINEER FOR POWER PLANT EQUIPMENT. Preferably graduate chemical or mechanical engineer. Must have knowledge of chemistry as applied to water conditioning. Traveling part of time, Minnesota and vicinity. Deferred classification in draft. Give complete particulars and salary desired in application. Address Box 1423, Power Plant Engineering, 53 W. Jackson Blvd., Chicago 4, Ill.

V. H. Peterson has been appointed Assistant to the President of The Baldwin Locomotive Works. Mr. Peterson has been vice-president of the Elliott Company for the past two years, in charge of all sales, advertising and service activities of the three plants of that company. Mr. Peterson is a graduate of Rensselaer Polytechnic Institute.

P. R. Greenman has joined the Ludlow Valve Manufacturing Co. as industrial sales engineer in the Chicago territory. Mr. Greenman is a graduate of the University of Illinois and is a mechanical engineer and designer of wide experience in power plant equipment, oil refinery and coal handling equipment.

Hugh E. Anderson has been appointed General Sales Manager of Honan-Crane Corp., Lebanon, Ind. Mr. Anderson has had wide experience in sales work, having been associated for many years with the Packard Motor Co. and more recently as sales manager for a leading firm of metallurgical engineers and as sales manager for the Park Chemical Co.

R. M. Cherry has been appointed assistant manager of the Industrial Heating Division of the General Electric Co., according to J. E. N. Hume, Commercial Vice President.

Mr. Cherry was born in Paris, Arkansas, and graduated from the University of Arkansas in 1919 with a B.E.E. degree in electrical engineering. The same year he became associated with General Electric as a testing engineer and since 1936 has been connected with the Industrial Heating Division.

Willard A. Luli has been promoted to the position of Factory Production Representative for the Mount Vernon, Ohio and Grove City, Pa. plants of The Cooper-Bessemer Corp. In his new position Mr. Luli will serve as the company's representative on the War Production Board for the Large Diesel Engine Manufacturers' Planning and Scheduling Committee.

E. J. Snetsinger has been appointed general manager of Magnetrol, Inc., a newly organized division of the Fred H. Schaub Engineering Co., Inc., Chicago, Ill. This new division will assume complete control of the manufacture and sale of Magnetrol automatic liquid level control units.

H. J. Barnsley, vice president of Jenkins Bros., has been elected to the governing board of Jenkins Bros. Ltd., Montreal, Canada, according to an announcement made by Farnham Yardley, president of the company. Mr. Barnsley has been with the company for 25 yr and makes his headquarters at the New York City office.

15,000 lb. EXCESS STEAM for Chemical Company

Upper portion of "S-A" boiler furnace showing water cooled rear wall and divided tube banks.

Reserve capacity in steam generators is doubly important today when ability to carry that extra load and unexpected peak means so much—also the "heavy duty" to maintain service when equipment replacements and additions are most difficult to make.

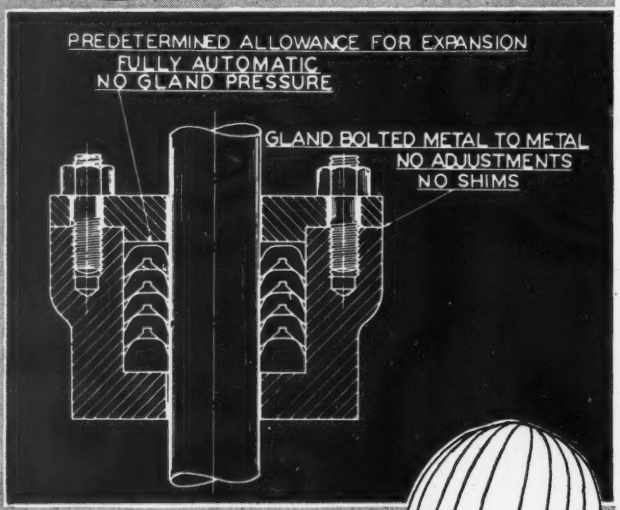
The "bonus" capacity of this "S-A" boiler has stood a prominent chemical company in good stead. Designed for 80,000 lb. of steam per hour, this modified "S-A" design—all convection heating surface placed on one side of furnace—has been operating effectively at from 90,000 to 95,000 lb. steam per hour. Fifteen thousand lb. "extra" steam per hour from unit shown above helps the all-out production effort of American industry.

This characteristic of "S-A" design, coupled with the all important factor of moderate material required per pound of steam generated, makes it an ideal steam producer for war or peace.

FOSTER WHEELER CORPORATION 165 Broadway, New York, N. Y.

FOSTER FW WHEELER

EXTRA
Packing Performance
at
NO EXTRA COST



Ask for
CHESTERTON
FULLY-AUTOMATIC
Parachute Packing
Manufactured by A. W. CHESTERTON CO., 64 India St., Boston

CHANGE OF ADDRESS

To avoid missing an issue or paying for forwarding postage be sure to send a change of address to our office. Changes received by the 20th of the month can be made effective for following month's issue.

POWER PLANT ENGINEERING

Charles R. Hook and Elisha Walker have been elected to the Board of Directors of Westinghouse Electric & Mfg. Co., as announced recently by A. W. Robertson, Chairman of the Board.

Mr. Hook is president of the American Rolling Mill Co. of Middletown, Ohio, and is a member and past president of the National Association of Manufacturers. He is also a member of the National Industrial Conference Board, the Business Advisory Council of the Department of Commerce and serves as chairman of the Industrial Relations Committee of the Council.

Mr. Walter is a partner in the firm of Kuhn, Loeb & Company.

MANUFACTURERS' NEWS

Army-Navy "E" Awards

Builders Iron Foundry
(Builders-Providence, Inc.)
Providence, R. I.
Carteret, N. J. Plant of
Foster Wheeler Corp.
Climax Engineering Co.
Clinton, Iowa
H. M. Harper Co.
Chicago, Ill.
Latrobe Plant of the
American Locomotive Co.
Wm. Powell Co.
Cincinnati, Ohio
Stewart-Warner Corp.
Chicago, Ill.
Sullivan Machinery Co.
Michigan City, Ind.

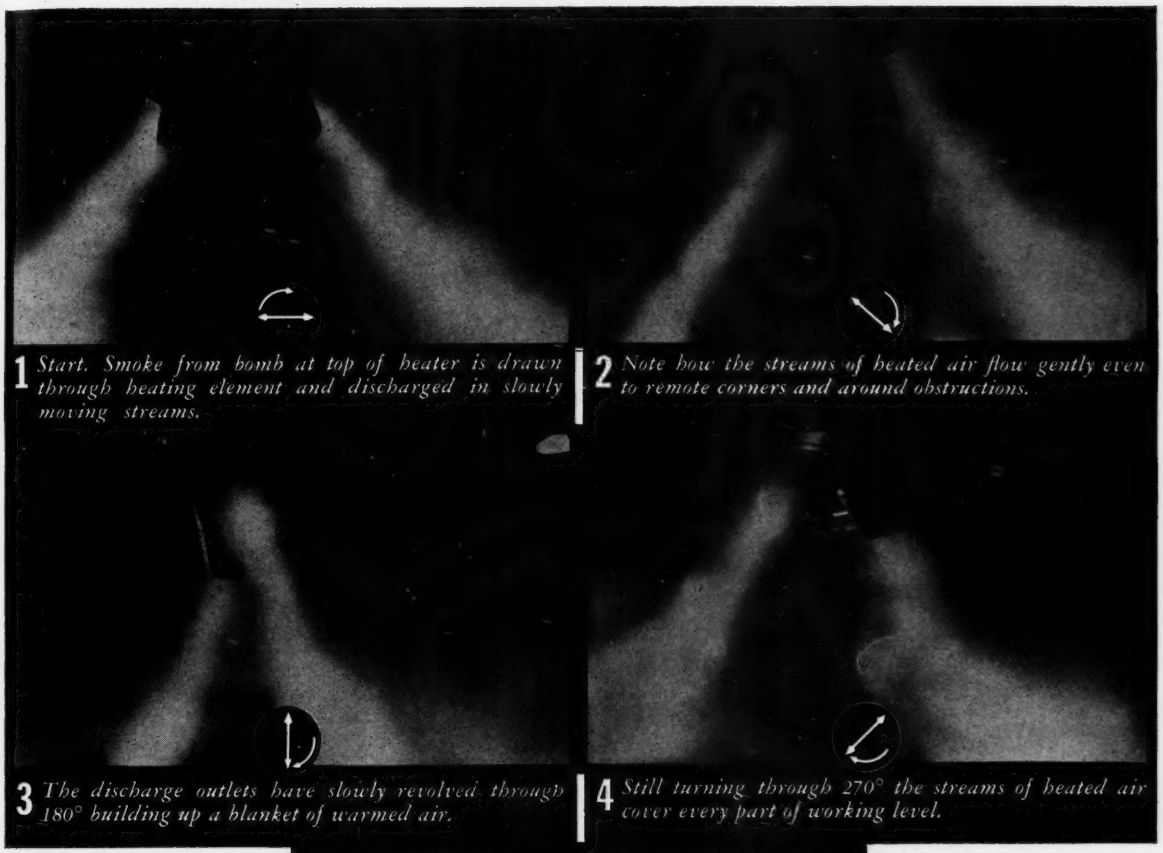
Standard Oil Co. of Indiana and subsidiaries are completing or have under way construction of manufacturing facilities estimated to cost upwards of $55,000,000 which will contribute directly to the war effort, President Edward G. Seubert announced in his 1942 report to 96,000 stockholders. For the most part they are financing the construction without government aid.

Earnings of the company for 1942 totaled $44,183,893, or $2.89 a share, as reported in a preliminary way on March 24. The 1941 earnings were $48,385,967, or $3.17 a share.

New brick and clay plant of the General Refractories Co. of Philadelphia is being rushed at Troup, Texas, and it is expected to be in production late this summer. Clay to be used is a distinctive type found near Troup and will be used for the manufacture of firebrick and related commodities.

General Refractories Co. in August, 1941, bought the Malakoff Brick Co. and converted its face-brick plant into a firebrick plant. In November, 1942, the Malakoff plant was destroyed by fire. The new site was then decided upon at Troup in order to use the special type of clay there. The new plant at Troup will employ sixty persons at the beginning.

WHY *Revolving* UNIT HEATERS ARE MOST EFFICIENT

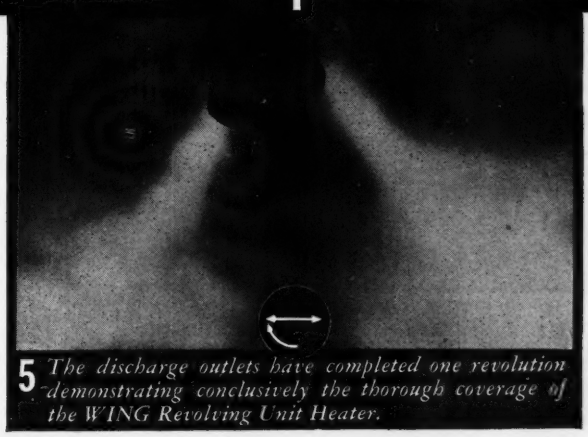


1 *Start. Smoke from bomb at top of heater is drawn through heating element and discharged in slowly moving streams.*

2 *Note how the streams of heated air flow gently even to remote corners and around obstructions.*

3 *The discharge outlets have slowly revolved through 180° building up a blanket of warmed air.*

4 *Still turning through 270° the streams of heated air cover every part of working level.*



5 *The discharge outlets have completed one revolution demonstrating conclusively the thorough coverage of the WING Revolving Unit Heater.*

The "smoke bomb" tests shown in these pictures are a convincing demonstration of the way in which WING Revolving Unit Heaters slowly spread a blanket of warmed air over the working area.

WING TIPS:

Many manufacturers who waited too long last winter to order their Revolving Unit Heaters were disappointed. Don't let this happen to you this year.

THERE is no other system of factory heating that can do what an installation of WING Revolving Unit Heaters does for factory workers. WING Revolving Unit Heaters gently circulate the warm air around bulky machinery and other obstacles and into otherwise cold corners, assuring a comfortable temperature at every part of the working level. The gentle air movement brings a sensation of fresh, live, invigorating warmth to workers.

Write for a copy of Bulletin HR-2.

7th Ave. and W. 14th St. **L. J. Wing Mfg. Co.** **Factories: Newark, N. J.**

WING *Revolving* UNIT HEATERS

Safe, rigidly controlled steam temperatures with *Swartwout* DESUPERHEATERS

You'll find it means much to your sense of security, where moderate steam temperatures are required, to have the dependable guaranteed control you get with Swartwout Desuperheaters. Complete station engineered to your requirements. Desuperheaters of the Carburetor, Venturi and Atomizer types have been developed to a high point of efficiency by Swartwout in more than 36 years experience with power plant equipment. For more complete details... write today to

THE SWARTWOUT COMPANY
18511 Euclid Avenue... Cleveland, Ohio

Swartwout Unit Responsibility... one complete service for reducing and desuperheating.

Feed Water Regulators • Pump Governors • Feed Water Heaters
Master Controls • Reducing Valves • Separators • Exhaust Heads

Swartwout
•Power Plant Equipment•

DO YOUR RECIPROCATING PUMPS RACE ALL DAY?

SLOW 'EM DOWN
SAVE STEAM WITH **COMBINATION**
NON-TILT, NON-SLIP VALVES

For Boiler Feed Vacuum, Condenser General Service

THE tilting action of some reciprocating pump valves permits the seat to wear unevenly—means the pump has to operate faster and waste steam to carry its theoretical load.

COMBINATION Pump Valves slow down and help save steam because they are built especially to prevent tilting and consequent slippage. Seat, stud and spring are made of long-lasting Phosphor Bronze. They match the fine performance of COMBINATION Silent Check Valves. Ask for descriptive folder with dimensions, prices and further details.

COMBINATION PUMP VALVE CO.
846 Wiota Street, Philadelphia, Pa.

The new main building of the plant will be 684 ft long and 100 ft wide. The main tunnel kiln will be 500 ft long and will include a 100-ft dryer and all modern facilities. L. Tuck Mosley, superintendent of the new plant, has been associated with the General Refractories Co. for many years in the operating divisions of their Danville, Ill., St. Louis, Mo., and Malakoff, Texas, plants.

The city of Ogden, Iowa, first sold its citizens electricity half a century ago and has owned the distribution system ever since.

After it abandoned its steam engine power plant, a public utility furnished electricity at 9 cents per kwhr for the first 20 hr, with a minimum rate of 6 cents per hour for all over 100 hr.

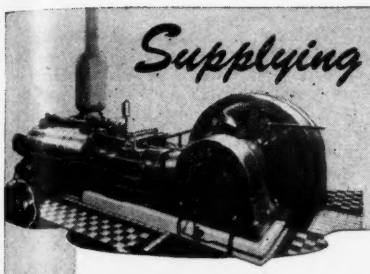
Since installing the three Diesel engines, as shown in the accompanying view, power costs were cut more than 50 per cent, permitting a rate of approximately 2 cents per kwhr. This reduction is claimed to have saved consumers more than $60,000 during the first four years of operation.

Interior view of 3-engine Municipal Diesel plant at Ogden, Iowa

Residents of Ogden took advantage of the lower rates to utilize more electric appliances. As a result, power production advanced at the rate of over 50,000 kwhr per year. Under the supervision of Superintendent W. J. Manion, it is believed that the earnings of the power plant will pay off the entire indebtedness before 1944.

One of the Diesel engines is a six-cylinder unit, the other two are four-cylinder units. Exhaust gas from the engines passes through Maxim silencers in a brick housing at the rear of the plant and motor-driven fans force in the hot air to heat the building.

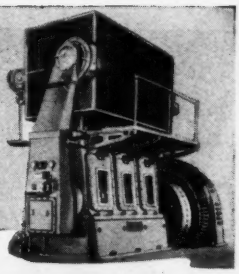
Herman W. Steinkraus, president and general manager of Bridgeport Brass Co., Bridgeport, Conn., announces the following promotions of Sales Department personnel: Austin R. Zender appointed general sales director; A. Dean Merwin appointed director of fabricating sales. George H. Baldwin will continue as general sales manager of the Mill Products Division. Announcement was also made of the following changes in field representatives: George H. Tobelman, eastern division manager and Carl J. Quanz, western division manager. Mr. Tobelman will supervise the activities of the company in Boston, Providence, New York, Newark, Philadelphia, Detroit, Cleveland, Pittsburgh and Cincinnati, and Mr. Quanz in Chicago, Milwaukee, Minneapolis, St. Louis, Houston, Denver, Seattle, San Francisco and Los Angeles.



Supplying Dependable, Economical

ELECTRIC POWER

for Industry



SKINNER "UNIVERSAL UNAFLOW" STEAM ENGINES

FOR three-quarters of a century the Skinner Engine Company has been building steam engines exclusively. The performance of Skinner Engines has been so outstanding that they have achieved the reputation of being "the most economical steam engines ever built."

Skinner "Universal Unaflow" Steam Engines, horizontal or multi-cylinder vertical, drive generators that furnish electricity for light and power to many of the nation's best known hotels, hospitals, department stores, office buildings and diversified industrial and institutional plants. By generating their own electric current instead of buying it from the local utility companies, these owners have saved millions of dollars in power costs. Other Skinner Engines drive compressors, pumps and blowers for refrigeration and air conditioning installations.

Tomorrow profits will come from economy. As in the past, many efficient power users will find that in no other department of their business can savings be effected equal to those made by using Skinner "Universal Unaflow" Steam Engines to generate power, utilizing the exhaust steam for heating and processing purposes.

Dependability and permanently maintained economy are inherent characteristics of Skinner Poppet-Valve Unaflow Steam Engines, and are largely responsible for the fact that more than 25% of all orders received are repeat orders. This is not only a high tribute, but also is testimony of complete satisfaction.

Although you may have a seemingly low *rate per kilowatt-hour* for purchased power, it will pay you to investigate, for postwar planning, how much lower your *cost* will be for power generated by Skinner Engines.

Our production facilities, at present, are devoted entirely to building Skinner Unaflow Steam Engines for the war program.

SKINNER ENGINE COMPANY FOUNDED IN 1868 **ERIE, PA.**

PUBLISHER

Famous metropolitan newspaper in Los Angeles, Cal. Three horizontal "UNIVERSAL UNAFLOW" Steam Engines, driving 572-kv.a., 3-ph., 60-cy., 240-v., A-C generators, with V-belted exciters. Steam pressure 190 psi., 150° F. s.h., back pressure 5 psi. Exhaust steam used for building heat and air conditioning. Installed in 1934.

OFFICE BLDG.

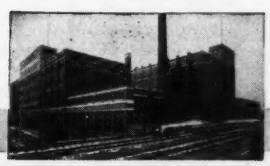
Prominent building in Philadelphia, Pa. Three horizontal "UNIVERSAL UNAFLOW" Steam Engines, driving 250-kw., 250-v. D-C generators. Steam pressure 190 psi., 50° F. s.h., back pressure 2 psi. Installed in 1922.

DEPT. STORE

Large store in Cincinnati, Ohio. One vertical, three horizontal "UNIVERSAL UNAFLOW" Steam Engines, with 250-v. D-C generators. One 300-kw. (1916); two 250-kw. (1927); one 800-kw. (1937). Steam pressure 140 psi., 25° F. s.h., back pressure 2 psi. Exhaust steam used for building heat and air conditioning.

Our Seventy-fifth Anniversary

1868 – 1943



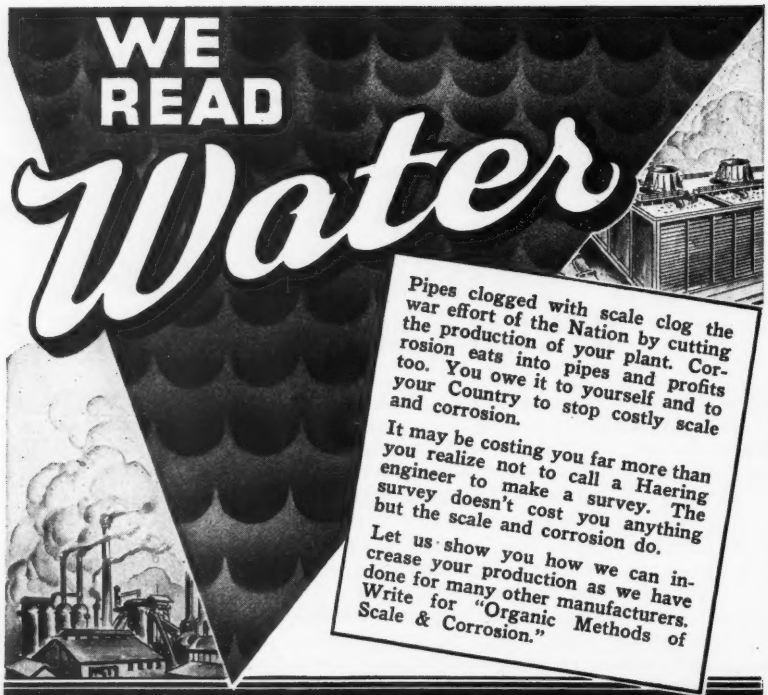
BAKERY

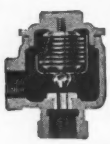
Nationally-known bakery in Buffalo, N. Y. Five horizontal "UNIVERSAL UNAFLOW" Steam Engines: one 167-hp., driving ice machine; four with 3-ph., 60-cy., 225-v. A-C generators, separate M-G exciter sets. Three are 250-kv.a., one 312-kv.a. Steam pressure 150 psi., 100° F. s.h., back pressure 2 psi. Installed in 1922, '24, '28. This company has purchased 25 "UNIVERSAL UNAFLOW" Engines.

LAUNDRY

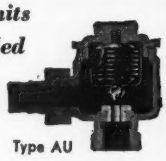
Modern laundry in New York City. Two "UNIVERSAL UNAFLOW" Steam Engines, with 219-kv.a., 3-ph., 60-cy., 208/120-v., 4-wire A-C generators, belted exciters. Steam pressure 150 psi., sat., back pressure 5 psi. Installed in 1931.

Proudly we fly the Army–Navy "E" Flag, awarded for excellence in production


WE
READ
Water
Pipes clogged with scale clog the war effort of the Nation by cutting the production of your plant. Corrosion eats into pipes and profits too. You owe it to yourself and to your Country to stop costly scale and corrosion.
It may be costing you far more than you realize not to call a Haering engineer to make a survey. The survey doesn't cost you anything but the scale and corrosion do.
Let us show you how we can increase your production as we have done for many other manufacturers. Write for "Organic Methods of Scale & Corrosion."
D. W. HAERING & CO., Inc.
GENERAL OFFICES:
205 West Wacker Drive Chicago, Illinois.

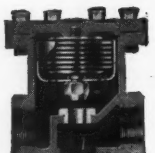

Type A

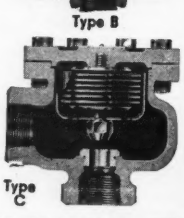
★ *No Water Logged Units*
★ *No Adjustment Needed*
★ *No Air-Binding*
★ *No Freeze-Ups*
★ *No Dribbling*


Type AU

5 BIG ADVANTAGES OFFERED USERS OF NICHOLSON *Thermostatic Industrial* TRAPS

All types drain completely and automatically . . . same adjustment used for any pressure, vacuum to maximum allowable . . . discharge air as efficiently as water . . . complete drainage when cold prevents freezing . . . closes immediately when steam contacts bellows. Five types, sizes 1/4" to 2", pressures up to 300 lbs. Bulletin No. 242.


Type B


Type C

Also

INVESTIGATE THE ADVANTAGES OF INSTALLING THESE OTHER NICHOLSON SPECIALTIES

Super-Pressure Piston and Weight Operated Traps

Compressed Air and Gasoline Traps

Steam Eliminators

Steam Separators

Welded Floats

Cylinder Control Valves

Send for Bulletins

W. H. NICHOLSON & CO., 160 OREGON ST., WILKES-BARRE, PA.

NICHOLSON *Traps*

THERMOSTATIC ▼ PISTON AND WEIGHT-OPERATED STEAM GASOLINE AND COMPRESSED AIR TRAPS ▼ ▼ ▼

CONTROL VALVES ▼ FLOATS ▼ MANDRELS ▼ STEAM AND AIR SEPARATORS

General Electric Co. is sponsoring a new radio program six nights weekly, 6:45 to 6:55 p.m., EWT, according to the announcement by Gerard Swope, president of the company. This new program, called The World Today, will bring listeners news transmitted by short wave from the men who see it happen, including William Shirer, Edward R. Murrow, Eric Sevareid, Charles Collingwood, and others.

NEWS FROM THE FIELD

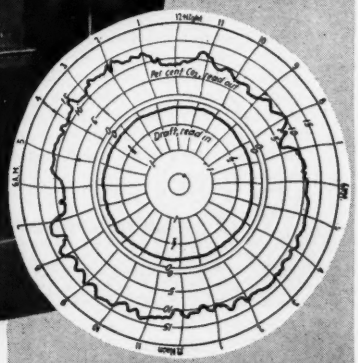
Electric-Operated Alumina Mill to Cost $2,600,000

VOLUNTEER PORTLAND CEMENT Co., Knoxville, Tenn., J. Ross Hanahan, president, has contracted with Government for construction and operation of new plant for the production of alumina, on site in vicinity of Harleyville (Dorchester County), S. C., where large tract of land has been secured. New plant will comprise an extensive group of one and multi-story buildings, including processing and production units, storage and distribution structures, machine shop, administration building and general utility structures. All machinery will be electrically-operated and will provide for an initial output of about 40 tons of alumina daily. Clay from Aiken County, S. C., will be used as main source of raw material, with lime to be secured from properties of Volunteer company in Dorchester and Orangeburg Counties. Power supply will be furnished by the Santee-Cooper Authority from its hydroelectric generating plant in vicinity of Pinopolis, S. C.; transmission line will be extended to plant site, where power substation will be located for mill service. Entire project is estimated to cost about $2,600,000, with financing in that amount to be provided by Defense Plant Corp., Washington, D. C., Federal agency. It is understood that American Nepheline Corp., Rochester, N. Y., producer of nepheline syenite, will be identified with development, and that a joint company will be formed with Volunteer organization to carry out project. Work is scheduled to be placed under way at once.

Proposed Hydroelectric Development in Idaho

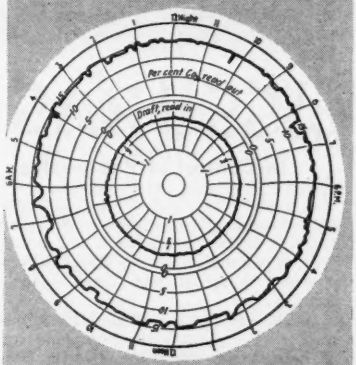
THE U. S. DISTRICT ENGINEER OFFICE, Pittock Block, Portland, Ore., has made preliminary surveys for a proposed hydroelectric power development on the Snake River, approximately 50 miles south of Lewiston, Idaho, where a tentative site has been selected. It is proposed to construct a power dam about 600 ft high at that point, providing a water head for an ultimate station capacity of close to 1,000,000-kw. Project would include a number of reservoirs for water storage, with transmission lines, switching stations, power substations and other facilities. The development is scheduled for post-war construction, and is said to be favored by the Bonneville Power Administration, Portland,

PROPERLY SIZED COAL... A "MUST" FOR THRIFTY BOILER OPERATION



CO_2 Records Show Need of Coal Sizing

The sizing of coal and its relation to ashpit losses is illustrated by the two CO_2 Charts herewith. Above shows what happens with poorly prepared coal. Below shows uniform CO_2 achieved through the installation of a coal crusher for better sizing.



Get more steam from your coal...

THE *American Crusher* WAY

IN line with the nation's program to conserve vital fuel supply, it's both patriotic and sensible to prepare coal for better sizing. This preparation results in a higher and more constant CO_2 reading—reduces the carbon content of the ash—makes your coal dollars produce more steam.

The experience of Bemis Bros. Bag Co., John Morrell & Co., Central Illinois Light Co. and scores of other plants is that AMERICAN Crushers — used in either stoker or pulverized coal burning—provide the proper coal preparation needed today for thrifty boiler operation. Many reports show that AMERICANS crush the coal exactly as required for top combustion efficiency, and at the extremely low crushing cost of *less than one cent a ton for all charges.*

The AMERICAN Rolling Ring Crusher, Type S, pictured above, has set new standards for efficient fuel sizing and trouble-free crusher operation through the use of heavy steel ribbed housing, anti-friction bearings, adjustable grinding plate, reversible manganese steel shredder rings which *split* coal instead of crushing it.

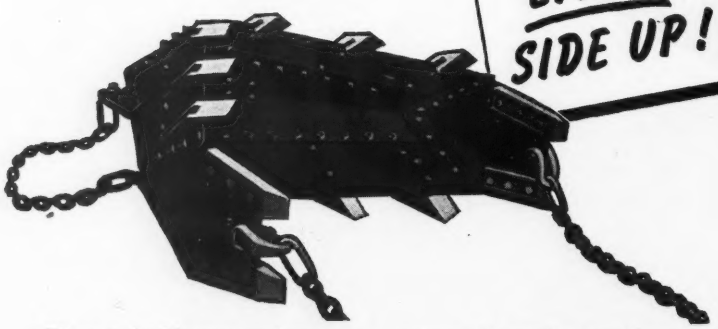
Ask our engineer to study your particular boiler plant operating conditions and offer suggestions for better sizing, lower steam costs. Write for descriptive bulletin on AMERICAN Crushers.

AMERICAN PULVERIZER COMPANY, 1429 Macklind Ave., St. Louis, Mo.

The "S" Type Is the Improved All-Steel AMERICAN RING CRUSHER

this cable drag scraper...

...DIGS EITHER SIDE UP!



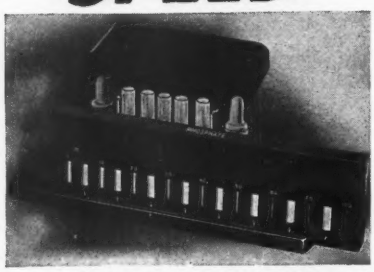
There is double wear, and no time lost in righting an overturned scraper, when you move stored coal with a Beaumont double-digging-edge unit. Digs evenly with minimum power consumption—pulls and returns without snaking—floats on material when conveying and does not push material on the return. Normally handles coal without digging teeth, which can be added for hard digging. Write today for full details.

In addition to complete dragline coal storage systems, Beaumont Birch manufactures and installs a full range of coal and ash handling equipment.

BEAUMONT BIRCH COMPANY
1505 RACE STREET PHILADELPHIA, PA.

ONE CONTRACT—ONE RESPONSIBILITY, FOR COMPLETE COAL AND ASH HANDLING SYSTEMS

SPEED



ACCURACY

In Control of Phosphates

The Taylor Phosphate Slide Comparator is an invaluable safeguard against delay caused by boiler shutdowns. With it, you secure two very important factors in TODAY'S high-powered industrial war drive—speed and accuracy.

It reduces corrosion and formation of scale . . . . controls the phosphate content of boiler water with the greatest accuracy and efficiency.

All Taylor color standards carry UNLIMITED GUARANTEE AGAINST FADING.

Write for booklet today—or see your dealer.

W. A. TAYLOR AND CO.
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Consult us for:

Radial Brick Chimneys
Common Brick Chimneys
Ornamental Chimneys
Linings for Steel Stacks
Chimney Repairs and Extensions
Installing, Repairing Lightning Rods

AMERICAN CHIMNEY CORPORATION
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BRANCHES: BOSTON, MASS.
PHILADELPHIA, PA. • PITTSBURGH, PA.
CLEVELAND, O. • DETROIT, MICH.

and the Department of Interior, Washington, D. C. No estimated cost has been announced.

Another projected development in the immediate vicinity, for which preliminary surveys likewise have been made, is that at Corral Creek, about 40 miles up the Salmon River. The program calls for the diversion of the river through a tunnel, approximately 9 miles long, to the Snake River, creating additional water supply for hydroelectric power development.

Robert M. Gates Nominated for ASME President

OFFICERS of The American Society of Mechanical Engineers for 1944 nominated at the Society's Semi-annual meeting in Los Angeles were announced by Benjamin P. Grawes, Chairman of the Nominating Committee, as follows: Robert M. Gates, President of Air Preheater Corp., New York City, is the nominee for president. Nominations for vice-presidents are David W. R. Morgan, Manager, Condenser Pump and Blower Division, Westinghouse Electric and Mfg. Co., Essington, Pa.; Jonathan A. Noyes, District Manager, Sullivan Machinery Co., Dallas, Texas; Ford L. Wilkinson, Jr., Dean of Engineering, Speed Scientific School, University of Louisville, Louisville, Ky.; and Rudolph F. Gagg, Assistant to the General Manager, Wright Aeronautical Corp., Paterson, New Jersey. Nominated as Managers are James M. Robert, Dean, College of Engineering, Tulane University, New Orleans, La.; Samuel H. Graf, Professor and Head of Mechanical Engineering, Oregon State College, Corvallis, Ore.; and Alton C. Chick, Assistant Vice-President, Manufacturers Mutual Fire Insurance Co., Providence, R. I. Election of the nominees will be held by letter ballot of the entire ASME membership of over 16,000, closing September 28, 1943.

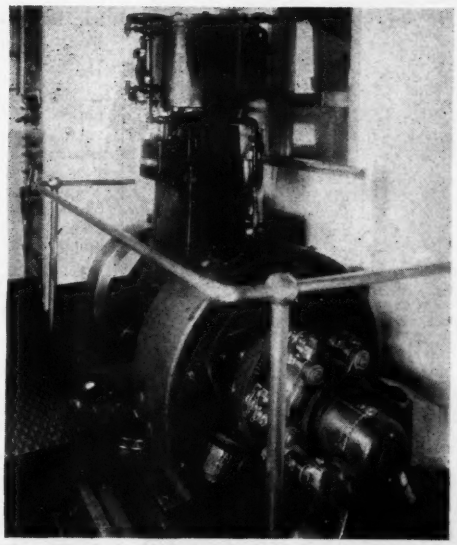
The H. K. Ferguson Co. Announces 25th Anniversary

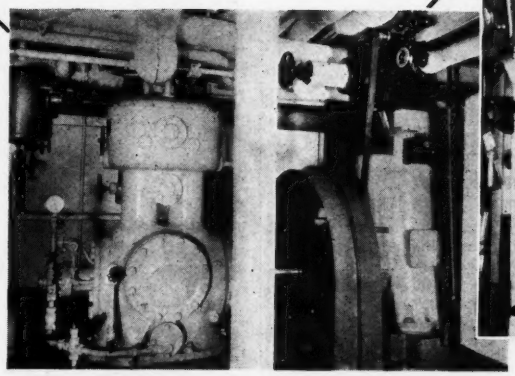
PRIVATE INDUSTRY'S RECORD in war production is a fair indication of the capability of business and industry to solve post-war problems for themselves and for the Nation, Harold K. Ferguson, president of The H. K. Ferguson Co., industrial engineers and builders, Cleveland and New York, said recently in a message commemorating the 25th anniversary of the founding of his company in 1918. It was one of the first organizations in the United States to offer "a complete industrial service," consisting of designing, building and equipping plants and factories ready for operation by their owners.

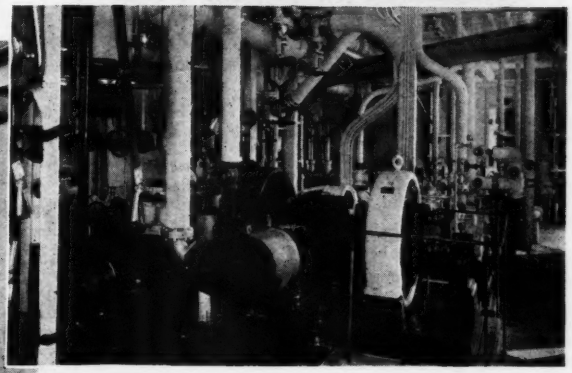
Addressing his own employees and associates, Mr. Ferguson complimented them for "record after record you have continually achieved since we in The Ferguson Company went to war in December, 1940, a full year ahead of Pearl Harbor.

Mr. Ferguson is credited with originating the "standard factory" principle of building, developed during World War I when manufacturers were clamoring for additional floor space. By convincing them they should erect buildings of standard design and construction, and by being able to supply prefabricated steel girders, he was able to guarantee delivery on plants and factories in from 45 to 60 working days. One of Mr. Ferguson's

TROY-ENGBERG







The Steam Engine that is Dependable
The Steam Engine that is Economical
The Steam Engine that is Flexible

The modern steam engine is, *under many conditions*, the best drive for such equipment as: stokers, fans, compressors, blowers, generators, and pumps. It offers these three basic advantages: dependability, economy and flexibility.

Its dependability has never been surpassed by any drive. Its economy often is highest and can be evaluated in several ways . . . in low cost of power, in quick paying off of the capital investment . . . in low cost of maintenance. Its flexibility is reflected in its closely controlled wide speed range.

Why not plan *today* for your Troy-Engberg Steam Engine to be made and delivered . . . if, as and when?

TROY ENGINE & MACHINE CO.

854 Railroad Ave. Troy, Penna.

7—TEM—3

YARWAY STRAINERS are *selling by the thousands* because they are better engineered for the service.

***"The Screen is the Thing"*—a high-grade, woven Monel wire screen that stops the dirt, lets fluids flow freely.**

Then too, purchasers like the *body finish—Cadmium plating inside and out* for protection against corrosion.

And last but not least, it is *"Easy to Clean"* having a steel blow-off bushing, precision machined with straight thread. Screen and bushing come out together—go back together, automatically aligning.

Six sizes, ½" to 2" for pressures up to 600 lb serve practically all strainer needs.

Sold by over 100 Mill Supply Houses. See your Supply House or write for Bulletin S-200.

YARNALL-WARING COMPANY
114 Mermaid Ave. PHILADELPHIA

boasts is that more than 80 per cent of the company's total volume of business has been repeat order business from a list of clients that includes such organizations as Radio Corporation of America, Procter & Gamble, General Electric, General Foods, Corning Glass, Union Carbide & Carbon, National Gypsum, Westvaco Chlorine Products, Pittsburgh Plate Glass, Western Electric, Ford Motor, Firestone Tire & Rubber, National Cash Register, Defense Plant Corporation, and Chemical Warfare Service, the Ordnance Department and the Corps of Engineers, and others of similar reputation.

N. E. Funk Made Doctor of Engineering

N. E. FUNK, vice-president in charge of engineering of the Philadelphia Electric Co., was awarded a degree of doctor of engineering by Lehigh University at its 75th commencement held at Bethlehem, Pa., on May 24.

Mr. Funk, a graduate of Lehigh in the class of 1905, has been associated with the Philadelphia Electric Co. since 1907. He is widely known as an author of electrical papers and is president-elect of the American Institute of Electrical Engineers. He is a member of the U. S. Chamber of Commerce and Philadelphia Chamber of Commerce and Board of Trade.

Electric Energy Requirements for March, 1943, Were 18.8 Per Cent Over March, 1942

FEDERAL POWER COMMISSION announced today that the electric energy requirements of the principal public utility systems of the country during March, 1943, totaled 17,414,670,000 kwhr, a gain of 18.8 per cent over the same month last year. Corresponding peak demands aggregated 32,709,131 kw, up 13.7 per cent over March a year ago. Comparable percentage increases reported for the preceding month were 15.6 per cent for energy and 9.4 per cent for demand in comparison with February, 1942.

The Commission stated that estimates of 1943 energy requirements made by the Class I electric utility systems in their March reports aggregate 215,692,722,000 kwhr for the year. Utility estimates of peak demands for December, 1943, are reported to amount to 37,841,042 kw. These figures represent decreases of some 269,000,000 kwhr and 59,000 kw from similar forecasts submitted by the utilities in their February reports.

The name-plate rating of new generating capacity placed in service during March totaled 148,600 kw. These new installations added 141,000 kw of dependable capacity, and the installation of a new boiler in an under-boilered generating plant added an additional 45,000 kw of dependable capacity. Scheduled net additions to the installed generating capacity of the principal systems are given as 3,085,050 kw at the end of 1943 and an additional 808,500 kw at the end of 1944. These figures include only those additions actually on order and authorized by WPB.

F P C Reports Utility Construction Budgets for 1943 Total $539,000,000

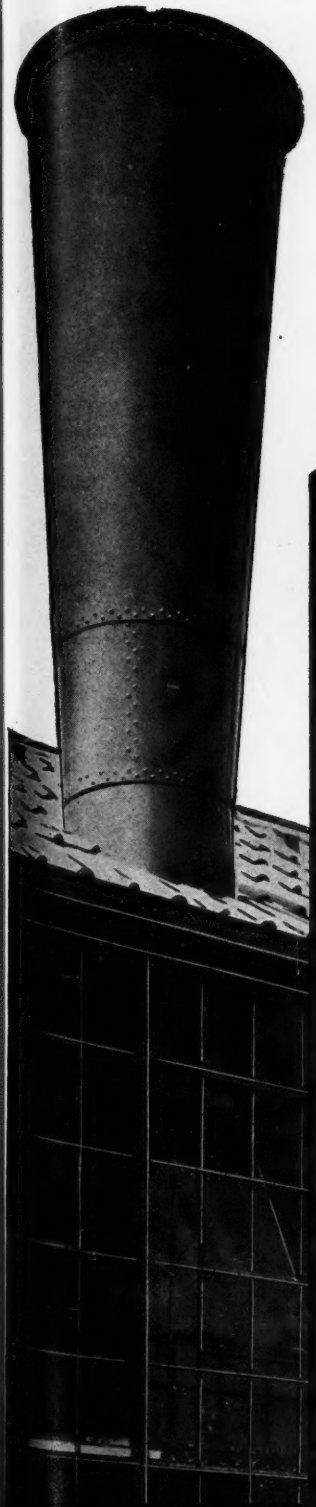
FEDERAL POWER COMMISSION has issued a report which shows that the elec-

YOU CAN DECREASE REFRACTORY LINING SHUTDOWNS WITH BRICKSEAL

CORRECTIVE-PROTECTIVE HIGHLY GLAZED MONOLITHIC COATING

- **Brickseal, a semi-plastic coating, prevents brick refractory linings from developing minute cracks or fissures in the brick or joints when forced to undergo rapid changes of temperature.**
- **Brickseal can be sprayed or brushed on easily. Once on, it will not crack, peel or blister and . . . it is impervious to acids, alkalis, and all combustion gases.**
- **SEE A BRICKSEAL SAMPLE . . . and find out how Brickseal makes a wall last longer . . . how it cuts down maintenance. Write or telephone today for a Brickseal representative. No obligation.**

BRICKSEAL REFRACTORY CO.
1029 CLINTON ST.
HOBOKEN, N. J.



Economize in Fan and Stack Operation

Alert executives are successfully combating the increase in new overhead costs with Thermix Fan-Stacks.

These stream-line Stacks cost less to install because there is less material and labor in their production than for a fan, breeching and stack, or for a chimney.

They save power because of fewer bends, turns and abrupt changes of area in gas passage.

They usually save in cost of fuel because they make boilers generate more steam with CHEAPER fuel.

They save in up-keep because the fan-blades—the principal wearing part—can be replaced inexpensively when worn, without removing fan wheel from casing or rebalancing the fan, by means of patented "Thermix blades."

The Thermix Stack is a combination of a Fan and Stack in one unit . . . operating as a unit, designed and built by a single, responsible manufacturer. You get complete co-ordination of the mechanical draft stack, the inlet breeching and all parts.

Thousands of Thermix Stacks are saving money for their owners today.

Write today for our interesting catalog No. 109.

PRAT-DANIEL CORPORATION, Port Chester, N. Y.

General Sales Agents

Thermix Engineering Co., Greenwich, Conn.

Representatives in Principal Cities

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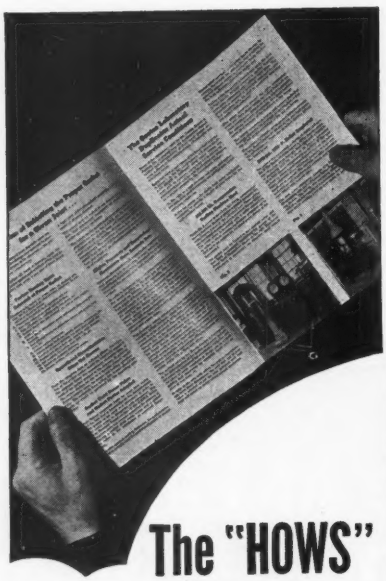

The "HOWS" and "WHYS" of GASKET ENGINEERING

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Do you know all the factors bearing upon the selection of the proper gasket for a particular service?

Enlightening information is contained in the current issue of "The Gasket"—the first of a series of technical bulletins to be issued by the modern Research Laboratory of the Goetze Gasket and Packing Company, oldest and largest manufacturers of industrial gaskets in America.

We will be glad to send these bulletins to you regularly, if you write on company letterhead, giving your position.

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tric utility industry contemplates construction expenditures during 1943 aggregating $539,000,000, of which $341,259,437 is budgeted for generating capacity; $75,979,535 for transmission line construction; $112,344,875 for distribution line construction; and $9,689,085 for general plant construction. The 1943 budget, the report says, is lower by some $216,000,000 than actual construction expenditures during 1942, which amounted to $755,000,000. Over a third of the anticipated decrease from 1942 expenditures to 1943 budgets is in the generating capacity classification which is expected to decline about $81,000,000, the report says. Other indicated decreases are transmission, some $65,000,000; distribution, $62,000,000; and general plant, $8,000,000.

Of the $539,000,000 total, $281,614,551 has been scheduled by privately owned utilities and $257,658,381 by publicly owned utilities. These figures may be compared with 1942 actual expenditures by privately owned utilities amounting to $455,974,727 and 1942 actual expenditures by publicly owned utilities amounting to $299,347,270. Inasmuch as some of the publicly owned utilities and projects report for fiscal rather than calendar years, budgets for 1943 include about $196,000,000 on the fiscal year basis and 1942 expenditures include about $216,000,000 for the 1942 fiscal year.

The new report, which has been designated as publication "FPC S-29" and entitled "Electric Construction Budgets—1943 and Electric Construction Expenditures—1942," may be obtained from the Federal Power Commission, Washington, D. C., at 10 cents a copy. Remittance should accompany order. Stamps are not acceptable.

ASME Issues Diesel Cost Data, Asks for More

LATEST in the well-known series of reports on oil engine power costs, compiled annually since 1929 by the Oil and Gas Power Division, ASME, is the report on oil engine power costs for 1941 just issued by the Society. Copies may be obtained from the Subcommittee on Power Costs, Oil and Gas Power Division, ASME, 29 West 39th St., New York City, price $1.25 with 20 per cent discount for members.

The report covers 151 actual plants, giving complete operating cost figures on each, along with data on type of plant and equipment and conditions of operation; data on such matters as fuel and lubricating oil consumption, costs of supplies, maintenance, repairs and supervision. In addition, production costs for 140 plants reporting for two or more years are given. Of these plants, 100 have reported for five or more years and 38 for ten or more.

In sending out this report, the Subcommittee on Power Costs requests the cooperation of all Diesel power plants in supplying data of this kind to the committee to aid the entire Diesel field in securing better Diesel engine and plant performance.

All operators are urged to keep accurate records of their operating costs and to send the data to the subcommittee, which will supply forms for reporting this data on request. Form A is used for reporting data on engines operating at 750 rpm or less and Form B for engines operating at speeds above 750 rpm.

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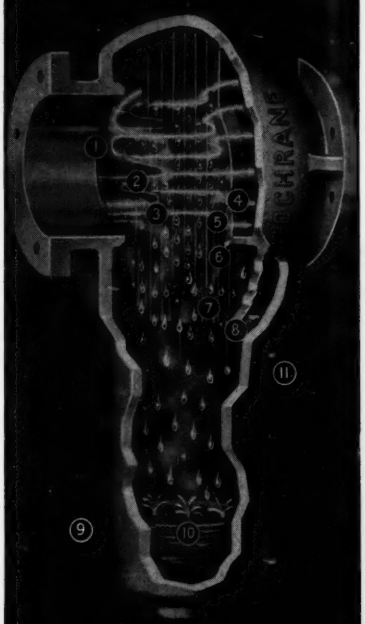

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HELPFUL BULLETINS

Practical answers to many wartime problems of plant operation and maintenance are found in the engineering bulletins offered by manufacturers. For your convenience we publish the following summary of helpful literature available. To obtain copies of the bulletins and catalogs described, simply indicate the paragraph numbers on coupon on next page, detach and mail.

BOILER PLANT EQUIPMENT

1 **High Capacity Stoker**—Bulletin 840 covers the design, operation and efficiency of Detroit Rotostokers. They provide high burning rates with fuels having ash of low fusing temperature. Detroit Stoker Co.

2 **Tubular Dust Collector**—New bulletin describes Thermix dust collector with tubes of non-priority corrosion-resistant fire clay. Collector assures high efficiency in handling fine dusts, powders and fly-ash. Prat-Daniel Corp.

3 **Boilers**—Bulletin G-28 describes B & W Design 32 cross drum boiler, a sectional header, straight tube unit for small industrial plants and other services requiring up to 6000 sq ft of heating surface. The Babcock & Wilcox Co.

4 **Pneumatic Spreader Firing**—Engineers faced with fuel changes or increased steam demands will be interested in free book on pneumatic spreader firing. Contains description of Iron Fireman stoker, capacities, operating data, etc., with layouts and photos of 10 installations. Iron Fireman Mfg. Co.

5 **Variable Capacity Oil Burners**—Catalog, 22 pg., describes a new type of mechanical pressure atomizing fuel oil burner adjustable over various firing rates without changing burner tips or oil supply pressure—illustrated, with useful engineering charts. Todd Combustion Equipment, Inc.

6 **Refractories Chart**—A new 6-pg. chart giving engineering information and uses for the complete line of Laclede-Christy refractories and refractory specialties. Products included are high temperature cements, coatings, plastics, fire brick, and insulating fire brick. The chart is especially valuable in helping to determine what refractory is the right one for any job. Laclede-Christy Clay Products Co.

ELECTRICAL EQUIPMENT

7 **Making Motors Last**—"Hints to Make Motors Last" is the title of handy little booklet. Check chart tells what to do when motor fails to start, runs hot, is noisy, shows excessive brush wear, etc. Westinghouse Electric & Mfg. Co.

8 **Contactors**—Ignitron contactors for fast, accurate power switching of a-c resistance welding machines are described in a new, illustrated 8-pg. bulletin (GEA-3058B). It outlines the many desirable features of these electronic contactors and describes their construction, the ease with which they can be installed, and the simplicity of their operation. The publication also illustrates three standard electronic contactors—the 150-, the 300-, and the 1200-amp sizes. General Electric Co.

9 **Brush Electroplating Process**—New Catalog No. 342 describes portable brush electroplating process for quick, economical deposition of silver on switch gear, busses, disconnects, cable lugs, instruments and other power equipment. No service interruptions. Process eliminates oxidation—gives greater electrical conductivity—prevent power losses. Book also tells of anti-corrosive applications on vats, tanks, etc. Consolidated Equipment, Inc.

10 **Hipersil Cores**—Designers of instrument transformers and other electromagnetic apparatus will be interested in Booklet B-3223 describing qualities of Hipersil cores. This new electrical steel is said to have 1/3 more flux carrying capacity, less size and weight, wider range of linear response. Westinghouse Electric & Mfg. Co.

11 **Alternating Current Welding**—Bulletin tells about distinctive operating features of new Ampac "200" alternating current welder. Unit is said to give operator correct voltage for the continuous range of currents available; handles rods 1/16 to ¼ in. size; provides high safe voltage for easy welding. Allis-Chalmers Mfg. Co.

12 **Power Distribution Panelboards**—Revised Bulletin 2500 covers Saflex power distribution panelboards designed to meet the rigid requirements of wartime industry for equipment employing interchangeable switch units. Special panels are built to government requirements. They are dead front and are approved by the Underwriters Laboratories, Inc. Square D Co.

13 **Insulators**—Specifications for low and medium-voltage pin-type lime-glass insulators, approved by the Transmission and Distribution Committee, Edison Electric Institute, are given in detail, with dimension drawings and curves of humidity correction factors, in a 16-pg. bulletin, TD-51, recently issued. Edison Electric Institute.

14 **Hand Book**—New Catalog gives details and prices on four new Mitchelite fluorescent units—Model No. 2075 for 2-40 watt lamps; No. 2076 for 3-40 watt lamps; No. 2077 for 2-100 watt lamps; and No. 2078 for 4-100 watt lamps. Illustrations show how new Mitchelite accessories provide for mounting or hanging to fit every lighting situation in factory or office. Graphs, tables and charts to simplify the selection of the proper fixtures for each job. Mitchell Manufacturing Co.

FANS, PUMPS AND COMPRESSORS

15 **Axial Flow Blowers**—High efficiency, compactness, quiet operation, non-overloading hp characteristics of Wing axial flow blowers are covered in new Bulletin CO-5. Contains performance curves; many blower installation views with all types of boilers. L. J. Wing Mfg. Co.

16 **Pumps and Hydraulic Equipment**—16 pg. illustrated catalog shows representative pumps and hydraulic equipment for power plants, oil fields, process industries and marine use. Text is descriptive of the many types of pumps shown and lists their applications. The Aldrich Pump Co.

17 **New Air Filter**—New bulletin describes the K-Master Kleen Air filter for compressed air and gas lines. The Porex filter cone used has a porosity of 50% and is said to permit high flow rates and an unusual amount of surface clogging before efficiency is impaired. Kaye & MacDonald, Inc.

18 **Pump Engineering Data**—How the single Westco turbine pump gives multi-stage performance, plus installation layouts and many pages of conversion tables and other timesaving pump engineering data are included in the new Westco Catalog just off the press. Joshua Hendy Iron Works, Pomona Pump Co. Div.

INSTRUMENTS AND CONTROLS

19 **Automatic Controls**—New Catalog No. 600 covers complete line of Mercoid automatic controls for heating, air conditioning, refrigeration and industrial applications. Controls have dustproof, non-sticking mercury contact switches. Catalog includes control wiring diagrams, specifications, conversion tables, other useful engineering data. The Mercoid Corp.

20 **Feed Water Control**—Bulletin No. 429A presents operating features and performance data on Copes Flowmatic regulator—a fully automatic, two element steam flow type feed water regulator. Also shows partial list of users. Northern Equipment Co.

21 **Differential Pressure Transmitter**—Design features, performance and specification data on the Republic pneumatic differential pressure transmitter are covered in new Bulletin No. 43-4. Instrument may be used for measuring flow or liquid level. Republic Flow Meters Co.

List Items You Want On Handy Coupon On Following Page

22 **Flow Rate Measurement**—Booklet No. 10-A, "A New Trend in Flow Rate Measurement", tells about the high visibility, instantaneous response, remote control, ability to measure corrosive gas or liquid, and other features of rotameter. Fischer & Porter Co.

23 **Measuring and Control Instruments**—Engineers will find in Bulletin Z6200 short descriptions and current prices of all Wheelco measuring and control instruments. Wheelco Instruments Co.

24 **Temperature Recorders** — With text, photographs and diagrams, Catalog "Micromax Temperature Instruments for the Steam Plant", explains instrument applications to temperature measurement of steam, feedwater and cooling water, and to fuel, combustion air and flue gas, are described in detail. Also describes principles of the thermocouple and potentiometer, the thermohm and the wheatstone bridge. Leeds & Northrup Co.

MECHANICAL TRANSMISSION

25 **Quick Detachable Sheaves**—The Worthington "QD" sheave—easy to get on, easy to get off—is described in new 16 pg. illustrated bulletin. Contains installation views, dimension tables and data of value to engineers with power drive problems. Worthington Pump and Mach. Corp.

26 **Wire Rope Conservation** — New bulletin contains helpful pointers on flushing, cleaning, lubricating wire cable so that its working life may be extended as much as 25%. Many sketches of lubricant application methods. The Keystone Lubricating Co.

27 **Belt Length Calculator** — New handy slide rule calculator makes it easy to figure belt length, once you know diameters of large and small pulleys, and center distance. J. E. Rhoads & Sons.

28 **Gears**—Combination catalog and gear data book, 72 pg. includes dimension tables for various gear types, as well as data on speed reducing units, motoreducers, and electric hoists. Also contains engineering data section. Philadelphia Gear Works.

29 **Flexible Joints Book**—A new book covering problems of remote controls, universal joints, shaft couplings, shaft hangers, operating gears, engine controls, etc., has been just released. Describes the new Brooks universal joint with positive and effective operating range at angles from 0 to 360 deg in any plane. Includes useful data sheets and blueprints. Brooks Equipment Corp.

PIPING, VALVES AND FITTINGS

30 **Steam Trap Tips**—Catalog 66 explains features of Strong steam traps. Also provides important trap facts, selector chart, steam table, installation tips of value to engineers and maintenance men. Strong, Carlisle & Hammond Co.

31 **Pipe Coatings**—New 82-pg. handbook tells how to prevent and cure damaging condensation on metal pipes and fixtures, basement walls, ceilings, concrete, etc. Contains instructions on application, coverage, drying time and many uses for Nodrip coating and other pertinent data. J. W. Mortell Co.

32 **Pipe and Stud Extractor** — How Reps extractors do away with preparatory steps formerly required in backing out broken pipe, tubes, bolts, studs and screws is described in new 4-pg. bulletin. Extractor grips without hammering; pulls rather than reams. Reps Tool Co. Inc.

33 **Piping Maintenance**—Six-pg. folder entitled "Short Cuts to Faster Piping Jobs" provides helps in meeting piping material shortages, and describes and illustrates a few examples of war-time piping ingenuity. One section tells how to get piping jobs done in the face of material shortages. Bulletin presents a few hints on using alternate materials, and on war-time installation practices. Crane Co.

34 **No-Thread Pipe Fitting** — What the Dresser No-Thread fitting is and how it works is described in new 16-pg. illustrated bulletin. Faster assembly, full wall strength, greater flexibility are advantages claimed. Booklet shows installation views with gas engines and compressors, water pumps, boiler control, oil lines, etc. Dresser Mfg. Co.

WATER TREATMENT

35 **Iron and Carbon Dioxide Removal**—Bulletin No. 252 describes the Ferrofilter method of removing iron and carbon dioxide from water. Unit consists of bed of graded anthracite media supported by a false bottom which forms a backwashable underdrain. Operation is simple, economical. American Well Works.

36 **Survey of Water Technology** — Booklet reviews progress made on subjects such as Water in the War Production Program, Process Water for Industry, Water Corrosion, Boiler Feedwater and Cooling Water. Under each of ten headings appear a brief description and listing of the important articles written on the subject during the past year. W. H. and L. D. Betz.

37 **Hot Process Softener** — "Operation of Hot Process Softener at 50 Lb. Gage Improves Performance and Saves Chemicals" by Messrs. C. E. Joos and Frank Kemmer of Cochrane Corp. has been published in reprint form. Illustrates the effectiveness of high temperatures in reducing hardness with lime and soda treatment with saving in both lime and soda ash, and describes what is believed to be the only hot process water softener operating at this high temperature utilizing lime and soda ash treatment on two stage softening method.

38 **Feedwater Treatment** — 4-pg. folder introduces Tanalginate, new protective and reactive colloidal material for conditioning boiler feedwater. Product is used in conjunction with such inorganic chemicals as phosphates or alkali. The Bird-Archer Co.

MISCELLANEOUS

39 **Manganese Steel Applications** — Bulletin No. 543-G, 48 pg., answers many questions about manganese steel and its properties; pictures and describes applications in pulverizers, pipeline fittings, elevators and conveyors, gears, and other equipment used in power plants, foundries, paper mills, etc. American Manganese Steel Div., American Brake Shoe Co.

40 **Metal Roofs and Siding**—Attractive 28-pg. booklet describes advantages and construction details of Felt-Cote asbestos protected metal roofs and siding for industrial building. High insulating property minimizes condensation and sweating — reduces fuel costs. American Steel Band Co.

41 **Quick Floor Repairs**—Explanatory folder tells how to apply "Instant Use" in patching broken or rutted floors. Material bonds to feather edge; can be applied over concrete or wood. Flexrock Co.

42 **Packing Reference Data** — New 44-pg. France packing catalog contains useful information on packing designs for various service, installation tips, methods of lubrication; also handy reference tables. The France Packing Co.

43 **Oil Purifier Manual**—New 20-pg. manual "The Installation and Operation of a Honan-Crane Oil Purifier", covers the following subjects:

Principle of Operation, Placing Purifier in Operation, Refill Instructions, Details of Installation, Factors Affecting Operation, When to Change Oil, Ordering Parts. The Honan-Crane Corp.

44 **Handbook for Welding Operators** —New 20-pg. pocket-size booklet entitled, "Handbook for the Welding and Cutting Operator" is written in an easy-to-understand style. It contains a list of concise do's and don't's for the man who welds the blowpipe and a wealth of other helpful information on the care and maintenance of blowpipes, regulators, and welding and cutting accessories. International Acetylene Assoc.

This coupon must be filled in completely in order to secure the literature you request. Please indicate only the bulletins you particularly desire. Pasting coupon on penny postcard saves you time and money.

JULY, 1943

POWER PLANT ENGINEERING

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45 **Properties of Synthetic Rubber**—New booklet, "The Five Commercial Types of Synthetic Rubber," traces the development of synthetic rubber from its laboratory beginnings. Includes photographs of manufacture, many diagrams, and a chart giving the relative physical and chemical properties of natural rubber and of the five types of synthetic rubber. United States Rubber Co.

46 **List of American Standards**—More than 600 standards covering mechanical, electrical, chemical and other engineering fields are given in the new list issued by American Standards Assoc. Covers specifications, methods of test for finished product, etc. A useful reference for engineering and purchasing departments.

47 **Storage-Tank Oil Heater**—A new bulletin on the G-Fin storage-tank oil heater explains the unique construction of the G-Fin elements which assures a lasting bond between fins and tubes or pipes and explains the different arrangements in which the heater is furnished, together with complete tables of dimensions and ratings. The Griscom-Russell Co.

48 **Surface Condensers**—New booklet on I-R surface condensers contains 36 pg. and more than 70 clean-cut illustrations, including numerous cross-sectional views. Among subjects discussed are structural and design features; steam penetration; air removal equipment; essentials of a condenser plant; condenser accessories and pumping equipment, etc. Contains technical information not ordinarily present in a bulletin of this type. Ingersoll-Rand Co.

49 **Heat Insulation Handbook**—Ehret's 85% magnesia and many other pipe and boiler heat insulating materials are fully treated, both as to selection and application, in a new 176-pg. Heat Insulation Handbook. Ehret Magnesia Mfg. Co.

50 **Research**—A complete list of books, magazine articles and patents, covering the researches in metals, fuels and allied subjects that have been published by the staff of the Institute during 1941 and 1942 is given in a recent 16-pg. booklet. This supplements the list for 1929 to 1940 inclusive published in 1941. Battelle Memorial Institute.

51 **Storage Water Heaters**—A new 6-pg. ADSCO Bulletin No. 35-75C illustrating and describing storage water heaters of the horizontal and vertical types with U-tube heating elements including details of construction, standard sizes, capacities and dimensions, etc., has been issued by the American District Steam Co.

52 **Manual On Spring Design**—Just off the press is a manual containing formulas of spring design and engineering for compression, extension, torsion, flat spiral or motor, flat springs, wire forms, etc., with illustrations, diagrams, and tables. New convenience in making out specifications, is afforded in detachable extension sheets following "blue-print" diagrams, with spaces for details, and inquirer's sketches if desired. Mid-West Spring Mfg. Co.

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SEVERAL TYPES OF TREATMENT had been tried but without success, as scale was still forming in the boilers. This necessitated frequent "blow-downs"—extra cost for steam—increased maintenance costs for periodic cleaning. It was agreed that the water should be treated *externally*, so as to *remove* all the detrimental solids *before* they got into the boilers.

TO REDUCE DISSOLVED SOLID content by as much as 80%, and to maintain the correct sulphate-alkalinity ratio, ILLCO engineers recommended a *combination-regeneration* reactor unit. This consisted of two tanks (54" diameter, 72" high) containing ion-exchange material to be *regenerated simultaneously with salt and acid.*

ABSENCE OF SCALE in the boilers was one result of the combination-regeneration equipment. (This salt-and-acid process, pioneered by ILLCO, has demonstrated its excellence for over five years in leading industrial plants.)

OTHER ADVANTAGES: "Blow-downs" were reduced to insurance company's minimum. By thus preventing its boilers from becoming "mud-and-sludge" containers, the plant effected a considerable saving in fuel. Supervision is required only for periodic regeneration. And on comparative cost of chemicals alone, the equipment will pay for itself inside of four years.

WITHOUT OBLIGATION we'll gladly make a similar survey of *your* boiler feed-water problem, suggest recommendations, describe our equipment in detail. Also engineered and manufactured by ILLCO are De-ionizing Units, Softeners, Filters, Aerator, Chemical Processing Equipment, etc. Write for literature.

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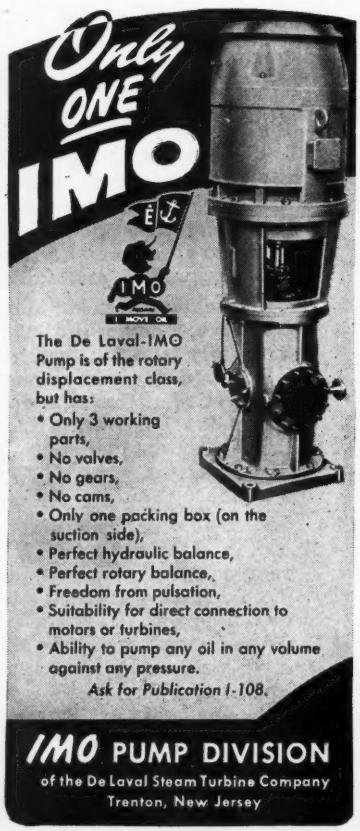
53 **Silent Chain Flexible Coupling**—Folder describes advantages and uses of Union silent chain coupling. Allows easy disconnection of shafts and separate section operation. Folder includes size selection table for most industrial applications. Union Chain & Mfg. Co.

* * * *

Following literature may be obtained only by writing directly to the manufacturer or group named.

Fuel Burning Regulations—New 24-pg. pocket size book, "Rules and Regulations Governing Details of Fuel Burning Equipment," has just been issued by Dept. of Smoke Regulation, Hudson County, N. J. A valuable guide for architects, engineers, contractors, equipment manufacturers, building and plant owners. Those interested may secure a copy by sending a 3c stamp directly to the Dept. of Smoke Regulation, Court House, Jersey City, N. J.

Power Transmission Catalog—New 180-pg. streamlined Link-Belt Catalog No. 850 covers representative types and sizes of power transmission and materials handling equipment. Dimensions, weights, list prices, and other pertinent data are given on chains, sprockets, silent and roller chain drives, bearings, baseplates, takeups, shafting, couplings, collars, clutches, pulleys, gears, buckets, conveyor idlers, screw conveyor, car spotters, speed reducers, etc. The book will be forwarded to anyone requesting it on business letterhead. Link-Belt Co., 307 N. Michigan Ave., Chicago, Ill.



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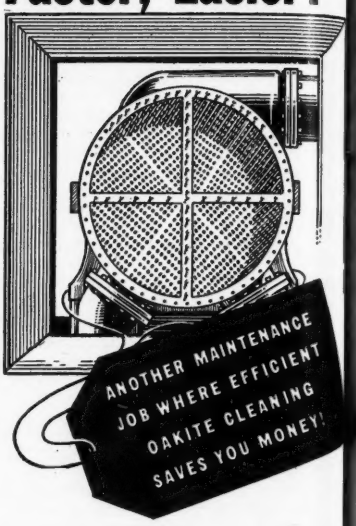

Are you faced with the job of producing more power with the same equipment? Then investigate this successful, low-cost way to improve surface condenser performance by thoroughly cleaning steam side of tube surfaces.

Introduce a solution of recommended Oakite material in condenser. Boil for required period, then rinse. Notice the fine, clean condition of tubes. Hot well temperature will go down, normal vacuum will be attained, dollars will be saved because of lower steam consumption.

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Whether it's cleaning surface condenser tubes, descaling a Diesel cooling system, a feed water pump, an evaporator, or a "lube" oil cooler, you are sure to find money-saving tips on how to do the job faster, easier in this 24 page cleaning manual. Write for your **FREE** copy today!

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When the alarm sounded, there was much excitement, but no confusion. The stall barriers dropped automatically, the trained horses leaped to their posts and the harness dropped into place from above. Steam was always up and, as the engines rolled out, a flare on the floor touched off the shavings and kindling in the firebox. Because they were so efficient and so simple, American fire departments became the models for the rest of the world.

The American preference for simplicity explains the performance records of Busch-Sulzer Diesels. Study their design and you quickly see the utter lack of complications. The trunk piston principle in larger 2-cycle, mechanical injection engines is an outstanding example. This innovation in larger Diesels was greeted with skepticism a dozen years ago, but proved performance has demonstrated its soundness. Whether for marine or stationary use, you can count upon a Busch-Sulzer Diesel for a long and lusty life.

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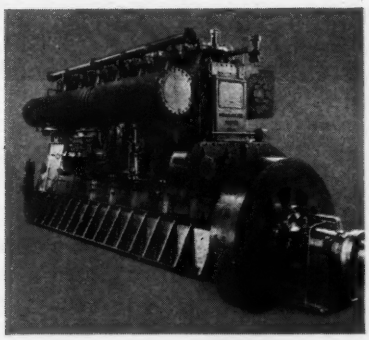

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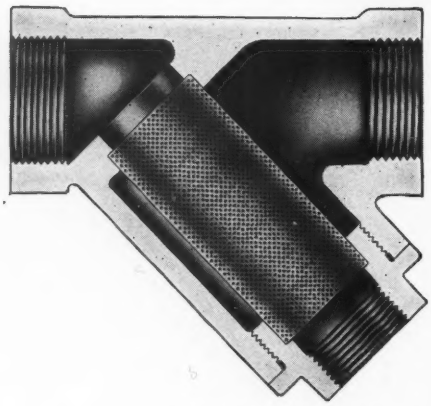

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K & M STRAINERS—"Y" *and Basket Types for use on steam, water, gas, air, oil, and other fluids. Note the oversized strainer basket area to assure minimum pressure loss. Baskets are easily accessible for cleaning. These features are typical of the simplicity and efficiency of K & M design.*

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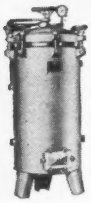

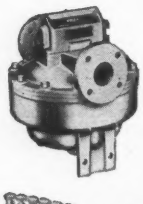

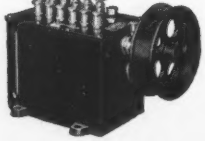

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Production! MORE Production! That's today's challenge to industry! More metal parts for planes, tanks, guns . . . more liquids . . . longer machine hours . . . mean that more liquids must be handled. And, that is where Bowser can help you . . . because it has specialized in liquid handling systems for 57 years. To help you, Bowser makes filters for cutting oils, coolants, water, petroleum products and many other liquids . . . accurate meters for measuring many kinds of liquids . . . lubricators and lubricating systems to keep machines running . . . wheel tanks, automatic liquid blending systems, stills for recovering cleaning and other solvents, flow indicating devices . . . and many other items. Whenever you have a problem of liquid handling . . . consult Bowser first! Have a Bowser man call —or write for a copy of the Bowser Industrial Equipment Catalog.

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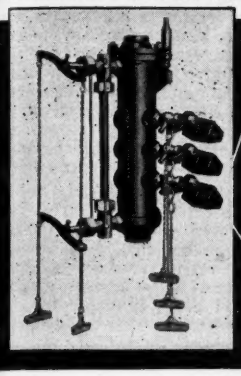

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Reliance ALARMS—the sturdy but sensitive water columns that have served industry for 59 years—have prevented untold millions of dollars of loss, both in equipment damage and in loss of production time. • At low or high pressures, the simple positive Reliance mechanism reports instantly every dangerous fluctuation of the water level by shrill whistle or electric signal. Minimum of maintenance required. Made in models for various types of boilers and for all pressures to 900 lbs. *Write for Catalog 414.*

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THE RELIANCE GAUGE COLUMN COMPANY
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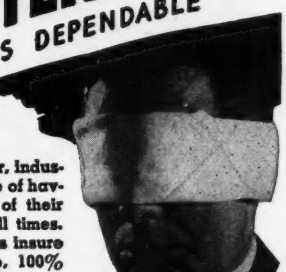
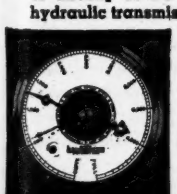
Reliance Boiler Safety Devices since 1884

We Don't Grope Blindly When Measuring Valuable Stored Liquids... We Check With LIQUIDOMETER *Tank Gauges*

"THEY'RE ALWAYS DEPENDABLE"



Now, more than ever, industrialists realize the importance of having accurate measurements of their stored liquids available at all times. LIQUIDOMETER Tank Gauges insure true, convenient, hazard-free, 100% automatic readings. No pumps, valves, or auxiliary units required to read them. Models are available so that readings can be taken remotely from or directly at the tank. Remote reading types utilize balanced hydraulic transmission system which completely compensates for temperature variations on communicating tubing. Accuracy unaffected by specific gravity of tank liquid.



Approved for gauging hazardous liquids by Underwriters' Laboratories and similar groups.

Models available to automatically control pumps, motors, signals or other devices for maintaining minimum or maximum liquid levels

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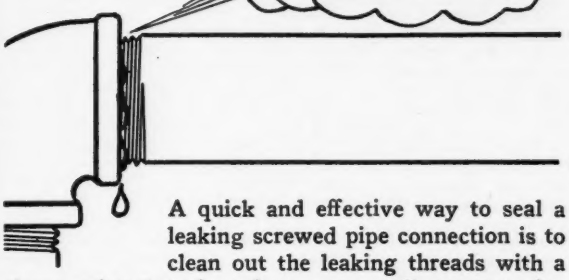

A quick and effective way to seal a leaking screwed pipe connection is to clean out the leaking threads with a sharp pointed tool, and tamp a small amount of a putty of SMOOTH-ON No. 1 into the leak while the pressure is turned off. When the SMOOTH-ON hardens in a few hours, the joint will be again ready for use . . . without having required dismantling or the use of heat. Leaks at flanged joints, either at the pipe threads, bolt holes, or around the circumference, can also be sealed with SMOOTH-ON.

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Pipe joint leaks are but one of many kinds of repairs that can be effectively, conveniently and economically made with SMOOTH-ON. This many-purpose iron repair cement also seals cracks in casings of pumps, heaters, engines, condensers and other cast shells, stops leaks at seams and rivets, and tightens loose fixtures and parts of apparatus and structures.

Today, more than ever before, SMOOTH-ON is a plant necessity because of the difficulty of obtaining new equipment and parts. Be sure to have a can handy to repair what you can't replace.

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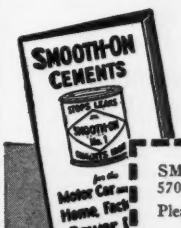
REPAIR HANDBOOK SHOWS HOW

40 pages, 170 diagrams, and simple concise instructions for practical repairs to plant equipment, pipe lines and structures. A necessity in every plant. Your copy sent FREE if you fill in and return the coupon.

Buy SMOOTH-ON in 7-oz., 1-lb., or larger containers from your supply house, or if necessary from us.



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Do it with **SMOOTH-ON**

NEW ENGINEERING BOOKS

Manpower. By The Research Institute of America, Inc. Size 8½ by 10 in.; 92 pp.; paper bound. Published as Research Institute Analysis 28 by The Research Institute of America, Inc., 292 Madison Ave., New York City.

From now until the end of the war, and even for sometime after, you will feel the burdens of labor shortage. This analysis points out in detail just how you can preserve your present working force, utilize it to the maximum, and recruit new workers.

The fresh stream of regulations in the field of labor supply, flowing from Selective Headquarters and the War Manpower Commission, means drastic pressure on your hiring policy. Yet in spite of this pressure you still have room for independent, intelligent action.

Your first objective should be to understand the regulations, particularly those referring to occupational deferment, job transfer, the mandatory 48-hr work week and other measures. Your next objective should be to set up a detailed policy of adjustment by which you can overcome the labor famine and keep your organization moving at top efficiency. Satisfactory achievement of both these goals is the purpose of this analysis.

In detail, the analysis treats the following topics: Your labor supply, cluded under the author's names and spreading war contracts; Your work week; Are you essential?; Non-Deferrable activities; Which employees will be in uniform?; Replacement schedules; Manning tables; Hiring controls, including Ten wartime hiring rules and job stabilization map; How to use the U. S. employment service; Tapping the labor reserve, including The use of women, Physically handicapped workers and Negroes and minority groups; Spreading the labor force, including Training, Absenteeism and Incentive pay; and Manpower machinery, including WMC Directory, Directory of field offices and TWI field offices.—C. R. E.

The Refrigerating Data Book. 5th Edition. Size 6½ by 9½ in.; 518 pp.; cloth bound. Published by The American Society of Refrigerating Engineers, 50 West 40th St., New York, N. Y. Price $4.00.

Various editions of the Refrigerating Data Book have been published since 1932. The 1941 edition was designated Volume II as a companion to the 1939 book, Volume I. With the present edition, the fifth, the former plan of a single volume is undertaken, but the information appearing in Vol. II, relating to applications of refrigeration, has not been included in this 5th Edition. Consequently, the latter is virtually a revision of the 1939 edition, covering basic principles and data, the refrigeration cycle and major kinds of refrigerating and air conditioning machinery.

This edition of the Data Book seems to us a most valuable combination of both the theoretical and practical refrigeration data that every engineer should have. Liberal use is made of tables and graphs as well as diagrams of refrigerating cycles and properties. A Mollier diagram for ammonia and tables for various refrigerants are included. The detailed drawings of equipment are also especially practical. Much new material is included under the authors' names and many chapters cover subjects more fully than in previous treatments in refrigeration literature.

Part I on refrigerating cycles covers the cycle in general, compression and absorption systems, properties of refrigerants, refrigerant tables, brine properties, and a refrigerating glossary; Part II gives fundamental data on heat transmission and insulation, load calculations, fluid flow and viscosity, lubrication, moisture, storage conditions, theory of freezing, and concludes with a discussion of refrigeration standards. Industrial systems are treated in Part III, including data on compressors, condensers, evaporators and freezing systems, pipes and piping, motors and electrical controls and low temperature systems. A chapter on machine operation is also included. Part IV describes the design and operation of domestic-commercial systems. In Part V, on air conditioning systems, the theory of air conditioning is treated, data are given on fans and ducts, small systems, controlled air conditioning, cooling towers and a good chapter on air conditioning calculations.

At the end of the book is the Refrigerating Catalog of manufacturers of equipment, a product index and the

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double adjustment.

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AUTOMATIC CONTROLS

FOR HEATING, AIR CONDITIONING, REFRIGERATION AND VARIOUS INDUSTRIAL APPLICATIONS

Mercoid DA Controls have attained universal use throughout industry. They are adaptable to a wide range of applications and available in a variety of types to meet the demands for accurate control of temperature and pressure.

The distinctive features in Mercoid DA Controls are the corrosion and dust-proof mercury switch; the Bourdon tube actuating element, and the outside double adjustment, which makes it easy even for inexperienced workers to set the operating range of these controls. The direct reading eliminates calculations.

Complete information in catalog No. 600. Write for a copy.

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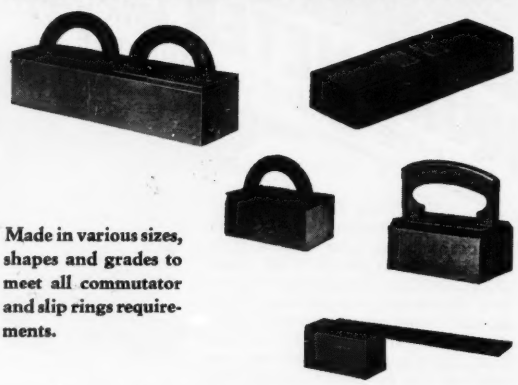

Made in various sizes, shapes and grades to meet all commutator and slip rings requirements.

Now more than ever Commstones are needed for faster, better and more economical motor maintenance. Martindale Commstones cut copper faster than a turning tool saving over 80% of the time required to turn a commutator in a lathe and over 75% of the cost. *Prompt deliveries on stock sizes.*

Send for our new Catalog No. 24 which gives full information on Commstones and many other maintenance tools.

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A year so different for all of us. A change in living, in habits, in lifelong customs. Ration coupons; not dollars, now buy the gasoline, steaks, shoes. Industry and manufacturing have their alphabetical program to follow. It's a far cry from our former methods to the way business is conducted in 1943.

INDUSTRIAL RUBBER PRODUCTS

The Rubber Industry has been forced to make many changes. Its achievements have been marvelous and ranks high with the progress made by any Industry. Since the call came, unbelievable quantities of Belting, Hose, and Packings have been made and supplied to Uncle Sam, a production feat unequalled by any other Industry.

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is playing an important part to

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Quaker has been right in step with changing conditions. Quaker is supplying large quantities of Belting, Hose, Packings and miscellaneous Moulded items to the Government and plants on war work. But, Quaker has been able to keep some Industrial Rubber Goods moving to those having an essential need for these critical products. It is our purpose to continue to do so.

FAITH and COURAGE

Must be Maintained

Some day . . . may it be soon . . . the conditions of today will change for the better. While they continue, all must keep faith; looking forward to the best, while preparing for the worst and having courage to take what comes until final VICTORY DAY is ours.

QUAKER

is looking to the future with confidence. Industrial Rubber Products are essential to our way of life. When peace time comes, Quaker will quickly adjust production to fill the vast needs of a civilian demand.

MAY THAT DAY BE SOON

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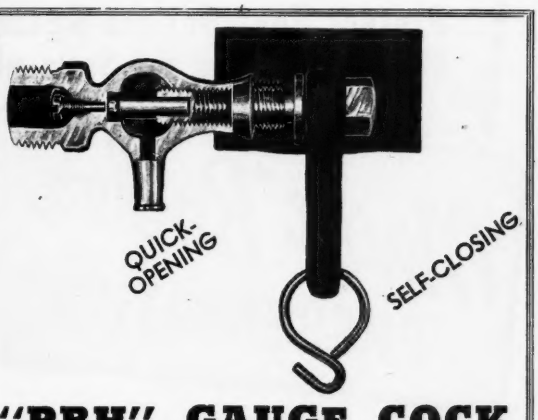

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A gentle pull opens this sturdy, long-wearing gauge cock and an adjustable weight automatically closes it when you let go. Removable monel metal seat and copper valve pencil insures leak-tight service.

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WATER GAUGES—*Vertical and Inclined*
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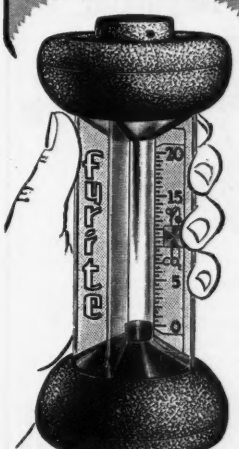
Expose Fuel Waste **INSTANTLY!**



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At Last . . . A PORTABLE "ORSAT"!

The amazingly simplified FYRITE "Orsat" Analyzer makes accurate flue gas tests easy—instantly telling you what percentage of your fuel is being wasted. The FYRITE is conveniently held in the hand while analysis is taken. It is accurate within ½ of 1% CO_2; spillproof in any position; rugged, durable, compact. More than 7000 in use.

OXYGEN ANALYZER designed on same principle available soon. Write for particulars.

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alphabetical list of ASRE members.—C. R. E.

A-C Network Operations, 1938-1940. A report of the Transmission and Distribution Committee, Edison Electric Institute. 38 pages, 8½ by 11, paper cover. Published by the Edison Electric Institute, 420 Lexington Ave., New York, N. Y., 1943. Price 60c to members and their employes: $1.50 to non-members in U.S.A.; $1.65 to foreign countries.

Sixty-nine companies submitted data on operations of 253 networks in 145 localities which have been compiled and tabulated for the period 1938-1940, inclusive. These data have been summarized, compared with data of previous reports wherever possible, and analyzed, in general, on the bases of per cent of peak load supplied and per cent of reporting companies.

The peak load served by low voltage A-C networks in 1940 was 1,781,729 kva, an annual increase of nearly 9 per cent since 1937. The total installed transformer capacity in low voltage A-C networks in 1940 was 4,065,355 kva, also an annual increase of nearly 9 per cent since 1937.

The 120/208-volt, 3-phase, 4-wire is still the most widely used network system. An attempt was made in this report to detect some trend within the three voltage groups; 115/199 volt, 120/208 volt, and 125/216.5 volt, 3-phase, 4-wire. No definite conclusions can be made, although there seems to be some slight trend to a higher voltage.

The practice by companies of regularly checking the operation of automatic net work protectors by opening station breakers has apparently detected faulty protectors before fault conditions occurred. The failure rate of protectors to open per 100 normal switching and testing operations was about 12 times the failure rate per 100 operations during fault, and compared to the 1937 report the failure rate for normal operations was doubled in 1940 whereas the failure rate for operations during fault was reduced to one-twelfth in 1940.

The failure rate of all secondary cables is about 2 failures per 100 mile years for the three-year period covered by this report. Fuses and limiters have operated in about 1 out of 4 cases protecting cables during fault. The failure rate of all transformers has dropped from about 1 per equivalent three-phase-bank years in 1937 to about one-half in 1940.

The number of complete network outages has continued to increase each year and the outage rate per locality per year has increased from 0.35 to 0.43 for 1937 and 1940, respectively.

The conclusions arrived at in this report are, for the most part, based upon the experience of the larger companies, as companies with less than 15,000 kva installed transformer capacity were not requested to submit complete data as they represent only 6.4 per cent of the total installed transformer capacity. Direct comparisons with the data of previous reports therefore cannot be made without these qualifications: that there were changes made in the questionnaire, that only partial data was requested from small companies, and that there were changes in the companies reporting.

Allied's Radio Data Handbook. Edited by Lieut. Nelson M. Cooke, United States Navy, U. S. Naval Research Laboratory, Washington, D. C. 48 pg, 6 by 9 in. Published by Allied Radio Corporation, 833 W. Jackson Blvd., Chicago, Ill., 1943. Price, 25c postpaid.

A comprehensive, condensed handbook of formulas, charts and data most commonly used in the field of radio and electronics. All subjects are clearly presented and conveniently arranged and cross-indexed for ready reference.

Divided into four parts: Mathematical Data, Radio and Electronic Formulas, Engineering and Servicing Information, and a complete set of four-place log and trig tables.

Formulas are given for decibles, resistance, capacitance, inductance, reactance, resonance, frequency, "Q" Factor, impedance, conductance, susceptance, admittance, transients, peak average and R.M.S. voltage and current values, meter shunts and multipliers, vacuum tube constants, etc.

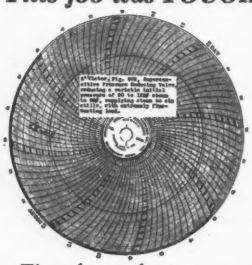
Data section contains such subjects as radio color codes, interchangeable tubes, pilot lamps, plug-in ballast resistors, coil winding, and others.

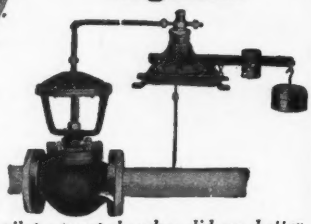
Should serve as a distinct aid to the student who is learning useful fundamentals, the serviceman who wants technical and maintenance data, the experimenter who wants nomographs and practical information, and the engineer seeking a time-saving reference.

An exceptionally useful and well-prepared book useful not only to workers in the radio field but to electricians generally. A big 25 cents worth.

This job was TOUGH for OTHER regulators but it was easy for

VICTOR
No. 802
Super-Sensitive
Regulator





The above chart was produced on a job that was "tough" for other regulators as reported by our representative. He said, *"First, a diaphragm valve did not regulate close enough. Second, a pilot operated valve did no better. Then they installed a VICTOR No. 802 and since then operation has been just about perfect."* Names on request.

This remarkable regulator is recommended for most exacting service—where delivery pressure must be maintained without perceptible variation, notwithstanding wide oscillations in the initial pressure or fluctuating loads.

It is easy to hook up Super-Sensitive VICTOR, as clearly pictured above.

"REGULATING VALVES FOR EVERY SERVICE" has been our slogan for nearly 50 years. Regulation is our specialty. See partial list of ATLAS Products in the coupon at the left.

Write your name, firm, and address on the margin of this page, tear out with the checked coupon, mail, and you will hear from us promptly.

ATLAS VALVE COMPANY
REGULATING VALVES FOR EVERY SERVICE
291 South St., Newark, N. J.
Representatives in Principal Cities

☐ Please send complete information on the VICTOR No. 802 Super-Sensitive Regulator. Also, please send information on the following Atlas products—

☐ Campbell Boiler Feed Regulators
☐ Damper Regulators
☐ Temperature Regulators
☐ Reducing Valves
☐ Exhaust Control Systems
☐ Pressure Regulators
☐ Pump Governors
☐ Float Valves
☐ Oil Control Cocks
☐ Humidity Controllers
☐ Thermostats
☐ Balanced Valves
☐ Control Valves

Protect Your Boilers Against Pitting, Corrosion and Scale with

Magic Boiler
PRESERVATIVE

• This modern boiler preservative contains colloids that possess absorptive properties. It holds all precipitates in suspension, while at the same time establishing a protective colloidal film on the metal to arrest pitting and corrosion. Its action is simple, safe, sure; helps your boiler produce more steam.

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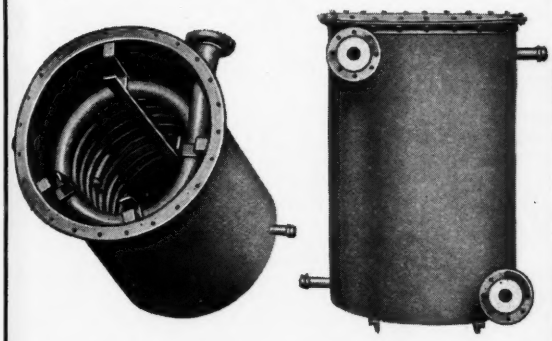
Coils, Bends and Assemblies

For Chemical Process Operations



Shown above is a large chemical lead coil and steel tank enclosure used in a pharmaceutical plant.

Of special importance is the method of lapping lead pipe ends over steel flanges to avoid any contamination.

Let us figure with you. Prompt deliveries.

REMPE CO.

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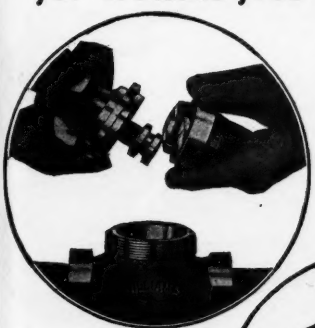
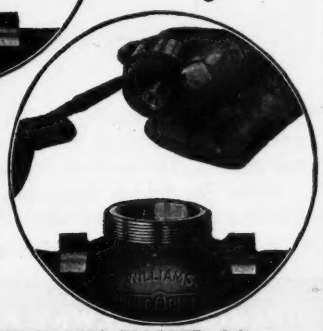
Use **VULCODISC**

for trouble-free valve jobs



In renewing the disc, note how easily and quickly the Vulcodisc Jiffy Disc Holder slips off the stem head. Only the disc lock nut to remove and the old disc is off and replaced in a jiffy.



Dense without being brittle—tough, yet resilient, Vulcodisc will not swell, warp or soften—in fact its absorption is less than 1 per cent. . . That is why an old Vulcodisc comes out of the disc holder as easily as a new one goes in. No need for hammer and chisel to cut the disc out in pieces—distorting and disfiguring the holder.

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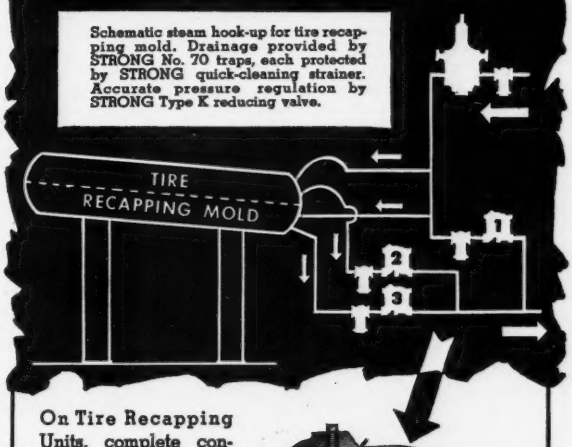
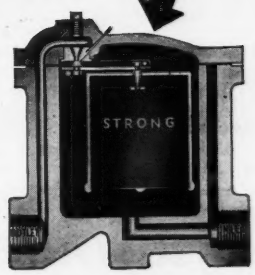
THE D. T. WILLIAMS VALVE CO.
Cincinnati, Ohio

STEAM WORKS HARDER

with the RIGHT TRAPS in the RIGHT PLACES


Schematic steam hook-up for tire recapping mold. Drainage provided by STRONG No. 70 traps, each protected by STRONG quick-cleaning strainer. Accurate pressure regulation by STRONG Type K reducing valve.
TIRE
RECAPPING MOLD
1
2
3

On Tire Recapping Units, complete condensate drainage is needed to assure the correct amount of heat at the mold. Three STRONG inverted bucket traps drain the (1) supply line (2) upper mold (3) lower mold.



STRONG 70 Series Trap Semi-Steel—for saturated steam to 150 p.s.i. working pressure.

The condensate rate is low, therefore, the patented STRONG anti-balancing device is valuable in preventing the "dribbling" which causes excessive wear. Strainers ahead of each trap prevent scale and dirt from interfering with operation.

• • •

Completeness of the STRONG lines enables us to recommend exactly the type and size you need—open or inverted bucket, closed float, float-and-thermostatic (blast), etc.—forged, fabricated, (welded), cast and semi-steel construction. Send your problems to Strong, Carlisle & Hammond Company, Cleveland, Ohio.

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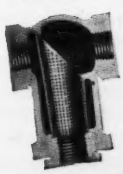
Reducing Valves

Strainers



Open Bucket Traps

PE 343

STRONG
STEAM SPECIALTIES

Power Plant Construction News

Ark., Fort Smith—Athletic Mining & Smelting Co., Fort Smith, will carry out expansion in plant for production for Government, including installation of machinery and electric power equipment for considerable increased capacity. Cost estimated about $550,000, with financing by Defense Plant Corp., Washington, D. C., Federal agency.

Calif., Los Angeles—McDonald Mfg. Co., 544 East 31st St., manufacturer of plastic products, plans installation of electric power equipment in new one-story addition, about 45x125 ft, on East 32nd St., reported to cost over $40,000, with machinery. George J. Fosdyke, 112 North Main St., is architect.

Calif., San Francisco—Bureau of Yards and Docks, Navy Department, Washington, D. C., has authorized expansion in naval air transport base at Mills Field, vicinity of San Francisco, including large hangar, shop, storage building and other structures. Electric power equipment will be installed. Also will make extensions in power substation facilities and electrical distribution lines. Entire project will cost about $3,500,000, and will be carried out under direction of 12th Naval District offices, San Francisco.

Fla., Zellwood—Florida Dehydration Co., Zellwood, and its affiliated interest, Zellwood Farms Co., are planning new ice-manufacturing and precooling plant, in connection with a general expansion program in local dehydration plant. Also, propose to build a new one-story canning plant, warehouses and other structures. Electric power equipment will be installed. Entire project is estimated to cost close to $500,000.

Ga., Dublin—Bureau of Yards and Docks, Navy Department, plans new naval hospital in vicinity of Dublin, consisting of a group of main buildings, with boiler house, power substation, cold storage and refrigerating plant, air-conditioning plant and system, and other facilities. Entire project is estimated to cost about $5,000,000. Proposed to begin work at early date.

Ill., Harvey—Ingalls-Shepard Division, Wyman-Gordon Co., 146th and Wood Sts., manufacturer of steel forgings, etc., plans installation of electric power equipment in new one-story plant addition for production for Government. Cost estimated about $1,400,000, with machinery. Financing will be provided by Defense Plant Corp., Washington, D. C., Federal agency. Schmidt, Garden & Erikson, 104 South Michigan Ave., Chicago, Ill., are architects.

Iowa, Sioux City—Sherman Food Processing Co., Sioux City, plans installation of electric power equipment in proposed new local dehydrating plant, on site at 206-10 Iowa St. It will be one-story, estimated to cost over $200,000, with machinery. Proposed to begin work soon.

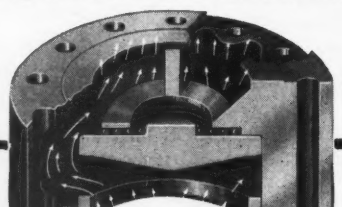
Mich., Adrian—Water Department plans early call for bids for new pumping station and water filtration plant for municipal water system, for which plans are being drawn by Finkbeiner, Pettis & Strout, Nicholas Bldg., Toledo, Ohio, consulting engineers, to be available in July. Cost is reported about $200,000. It is understood that a priority rating will be secured.

Minn., Fergus Falls—Fergus Falls Co-operative Creamery Association, Edward C. Peterson, president, plans installation of electric power equipment in proposed new one and two-story dry milk processing plant, estimated to cost close to $200,000, with machinery. It will be operated in conjunction with local creamery. Max O. Buetow, 1931 University Ave., St. Paul, Minn., is architect.

Minn., Red Wing—Northern States Power Co. of Wisconsin, Eau Claire, Wis., is said to have preliminary plans under way for new steam-electric power plant in vicinity of Red Wing as an early post-war project. Cost is estimated in excess of $1,500,000, including transmission line extensions.

Mo., St. Louis—Blanton Co., 3400 North Wharf St., manufacturer of oleo-

WILLIAMS-HAGER
Flanged Silent Check Valves



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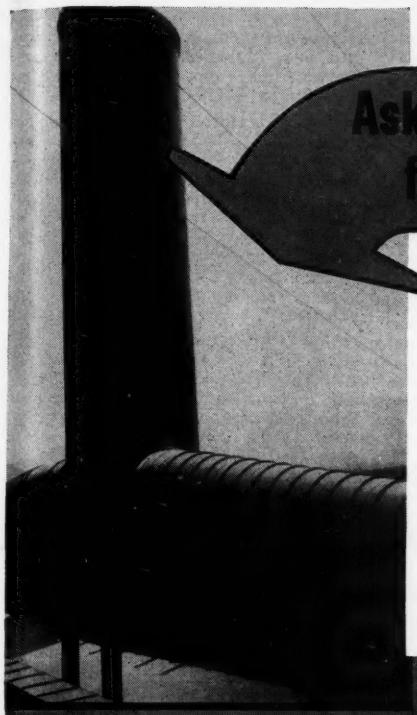

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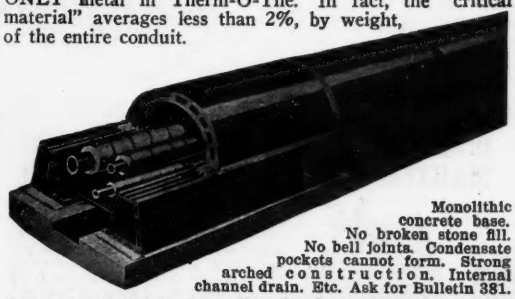

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INSTANT-USE

FLEXROCK CO., 2323 Manning St., Phila., Pa.

margarine, oil products, etc., plans installation of electric power equipment in new soy bean processing mill on neighboring site, for which superstructure will begin soon. Cost reported over $100,000, with machinery. Gray & Pauley, 3800 West Pine Blvd., are architects.

N. J., Bloomfield—General Electric Co., 5 Lawrence St., has approved plans for new one-story boiler house at plant, reported to cost close to $45,000, with equipment. Proposed to begin erection at once.

N. J., Kearny—Federal Shipbuilding & Dry Dock Co., Inc., Lincoln Highway, plans installation of electric power equipment in new one-story addition, about 75x300 ft, to be used primarily as an assembling shop. Cost reported about $100,000, with machinery. Work will be placed under way at once.

N. J., Perth Amboy—Perth Amboy Dry Dock Co., foot of Broad St., plans installation of electric power equipment in new one-story boiler and plate shop at plant. Cost reported about $50,000, with equipment. Erection is scheduled to proceed at once.

Ohio, Akron—B. F. Goodrich, Akron, manufacturer of rubber products, will carry out expansion in plant for production for Government, with installation of machinery and electrical equipment for considerable increased capacity. Cost estimated about $900,000, with financing to be provided by Defense Plant Corp., Washington, D. C., Federal agency. Work will proceed soon.

Ohio, Cleveland—American Magnesium Corp., 2210 Harvard Ave., has plans for new one-story boiler house at plant, about 45x100 ft, reported to cost over $65,000, with boiler units and auxiliary equipment. Malcolmson-Calder & Hammond, 1217 Griswold St., Detroit, Mich., are architects; Snyder & McLean, Penobscot Bldg., Detroit, are consulting engineers.

Ohio, Dayton—U. S. District Engineer Office, Wright Field, Dayton, has completed plans for new one-story power plant, 122x122 ft, at a Government project in Greene County, near Dayton. Proposed to begin construction soon. No estimate of cost announced.

Ohio, Warren—Brainard Steel Co., Larchmont Avenue, N. E., manufacturer of fabricated steel products, has acquired an industrial plant in East Orwell district, previously used as a creamery, and will remodel and equip for new branch plant for production of steel tubing for Government. Electric power equipment will be installed. Entire project is reported to cost close to $100,000.

Pa., North East—Sunshine Packing Corp., North East, has plans under way for new one-story cold storage and refrigerating plant, reported to cost over $35,000, with equipment. C. S. Kirby, Commerce Bldg., Erie, Pa., is architect.

Texas—War Department, Washington, D. C., has authorized new army air force base in Dallam County, exact location not announced, consisting of shops, hangars, warehouses and other industrial buildings. Electric power equipment will be installed. Also plan power substation, with electrical distribution system. Entire project will cost over $1,000,000, and will be carried out under direction of U. S. District Engineer Office, Tulsa, Okla.

Va., Hampton—Virginia Public Service Co., Alexandria, Va., has approved plans for addition to steam-electric generating station at Hampton, with installation of additional equipment, and work is scheduled to proceed at once. Contract for building construction has been let to Allen J. Saville, Inc., Electric Bldg., Richmond, Va. No estimate of cost announced.

Wis., Emerald—Emerald Co-operative Creamery Association, Chester L. Nelson, manager, has plans maturing for new boiler house and dryer room addition, one and two-story, about 40x59 ft. Cost reported close to $40,000, with equipment. A priority rating has been asked. Klinger, Hubbard & Gohn, 218 South Barstow St., Eau Claire, Wis., are architects.

Wyo., Laramie—Monolith Portland Midwest Co., Laramie, with local cement mill, plans installation of electric power equipment in proposed new plant on local site for production of alumina for Government, comprising large group of one and multi-story units, equipped for heavy output. A boiler house and power substation are planned, with machine shop and other utility structures. Entire project is reported to cost about $4,000,000, and will be financed by Defense Plant Corp., Washington, D. C., Federal agency. Company is a subsidiary of Monolith Portland Cement Co., 215 West Seventh St., Los Angeles, Calif.

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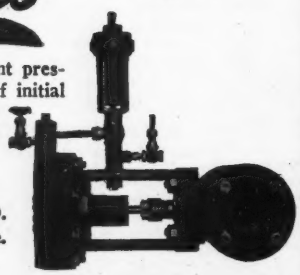

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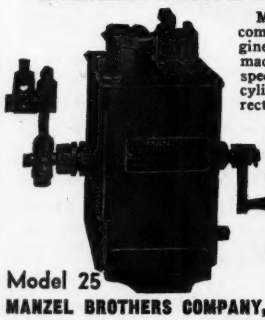

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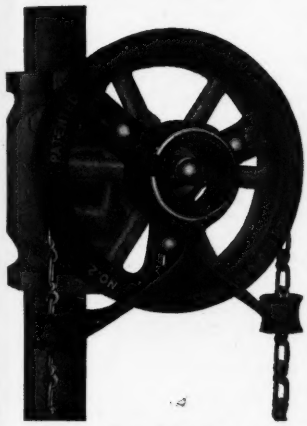

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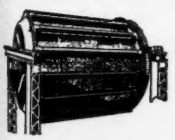

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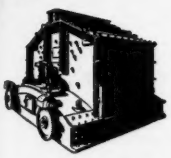

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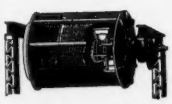

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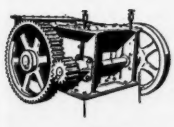

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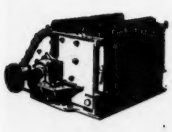

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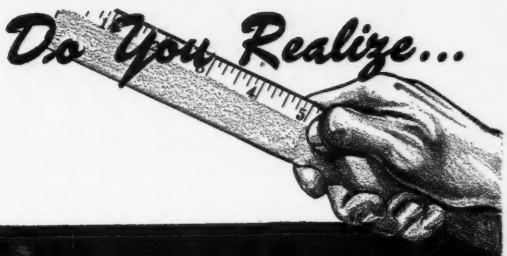

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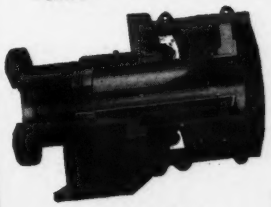

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Allis-Chalmers Mfg. Co. 41, 46
Allpax Co., Inc., The.....142
American Blower Corp. 20-21
American Chain & Cable Co., Inc...125
American Chimney Corp. 152
American Coal Burner Co. 120
American District Steam Co. 171
American Engrg. Company.....16-17
American Photocopy Equip. Co. ... *
American Pulverizer Co. 151
American Radiator & Standard Sanitary Corp. 20-21
Anderson Co., The V. D. 140
Anderson-Stolz Corp. ..... *
Arkansas Fuel Oil Co. 40
Armstrong Machine Works..... 14
Atlas Valve Co. 167

Babbitt Steam Specialty Co. 171
Babcock & Wilcox Co., The.....22-23
Bacharach Ind. Inst. Co. 165
Bailey Meter Co. 30
Baldwin De La Vergne Sales Corp.. *
Baldwin-Hill Co. 159
Baldwin Locomotive Works..... *
Beaumont Birch Company.....152
Belmont Packing & Rubber Co., The *
Bendix Aviation Corp. ..... *
Betz, W. H. & L. D. ..... *
Biddle Co., James G. 45
Bird-Archer Co., The.....105
Blackmer Pump Co. ..... *
Bowser & Co., Inc., S. F. 162
Brickseal Refractory Co. 154
Brown Instrument Co., The..... *
Brunt Equipment Co. ..... *
Burgess Battery Co. ..... *
Busch-Sulzer Bros.-Diesel Engine Co.161

Canton Stoker Corp. ..... *
Cash Company, A. W. 43
Chapman Valve Mfg. Co., The.....Inside Back Cover
Chesterton Co., A. W. 146
Cities Service Oil Co. 40
Clipper Mfg. Co. 138
Cochrane Corporation 42, 156
Combination Pump Valve Co. 148
Combustion Engrg. Co., Inc. 26-27
Condenser Service & Engineering Co., Inc. 135
Connery Construction Co. 169
Cook's Sons, Inc., Adam..... *
Coppus Engrg. Corp., Inc. 143
Corning Glass Works.....128
Crane Co. 95
Cutler-Hammer, Inc. ..... *

Dampney Company of America, The *
Dart Mfg. Co., E. M. 124
Davis Regulator Co. ..... *
Dearborn Chemical Co. 113
DeLaval Steam Turbine Co. 38, 160
Detrick Co., M. H. ..... *
Detroit Stoker Co. ..... *
Dowell Incorporated ..... *
Dravo Corporation 170
Dravo-Doyle Co. ..... *

Edward Valve Mfg. Co., Inc., The.. 93
Ehret Magnesia Mfg. Co. ..... *
Electric Chemical Co. ..... *
Electroweld Steel Corp. ..... *
Elgin Softener Corp. ..... *
Elliott Co. 2-3
Engineer Co., The.....126
Ernst Water Column & Gage Co. .. *

Fairbanks Co., The.....127
Fairbanks, Morse & Co. ..... *
Fischer & Porter Co. ..... *
Fisher Governor Company.....139
Flexrock Co. 169
Flori Pipe Co., The..... 32
Flynn & Emrich Co. ..... *
Foster Engrg. Company.....116
Foster Wheeler Corp. 145
France Packing Co. ..... *
Fuller Company 118

Garlock Packing Co., The..... *
Garratt-Callahan Co. 166
General Electric Co. 115
Gifford-Wood Co. ..... *
Gilmer Company, L. H. 121
Globe Steel Tubes Co. ..... *
Goetze Gasket & Packing Co., Inc...156
Golden-Anderson Valve Specialty Co.132
Graver Tank & Mfg. Co., Inc. 141

Haering Co., D. W. 150
Hagan Corporation 18-19
Hall Laboratories, Inc. 18-19
Hays Corporation, The..... 97
Hendy Iron Works, Joshua..... 6
Henszey Company 130
Hercules Float Works..... *
Honan-Crane Corp. ..... *
Huyette Co., Inc., The Paul B. 165

Illinois Water Treatment Co. 160
Infilco, Incorporated 44
Ingersoll-Rand ..... *
International Nickel Co. 131
Iron Fireman Mfg. Co. 24-25

Jenkins Bros. ..... *
Johns-Manville ..... *

Kellogg Co., The M. W. 47
Kennedy Valve Mfg. Co., The.....111
Kieley & Mueller.....162

Ladish Drop Forge Co. 31
Leavitt Machine Co. 133
Leeds & Northrup Company..... *
Link-Belt Co. ..... *
Liquidometer Corp., The.....163
Lummus Co., The.....119
Lunkenheimer Co., The..... 91

Magnolia Metal Co. 134
Manzel Bros. Co. 170
Marley Company, The..... *
Martindale Electric Co., The.....164
Martin-Gibson Co. ..... *
Maxim Silencer Company, The..... *
McGraw-Hill Book Co., The..... *
Mercoid Corp., The.....164
Midwest Piping & Supply Co., Inc..109
Minneapolis-Honeywell Regulator Co. *
Murray Iron Works Co. 142

National Aluminate Corp. 89
National Valve & Mfg. Co. ..... *
Neerup Industrial Engineering.....140
Nicholson & Co., W. H. 150
Northern Equipment Co. 99
Norton Company ..... *
Nugent & Co., Inc., Wm. W. ..... *

Oakite Products, Inc. 160

Pennsylvania Crusher Co. 17
Permutit Co., The.....Back Cover
Philadelphia Gear Works..... *
Pomona Pump Co. ..... *
Porter & Co., Inc., H. W. 169
Powell Co., The Wm. 123
Prat-Daniel Corp. 155
Pritchard & Co., J. F. 137
Proportioneers, Inc. ..... *

Quaker Rubber Corporation.....165

Raybestos-Manhattan, Inc. ..... *
Reading-Pratt & Cady Div. of American Chain & Cable Co., Inc. 125
Reliance Gauge Column Co. 163
Rempe Co. 167
Republic Flow Meters Co. 34
Richardson Scale Company..... *
Ric-Wil Company, The..... *
Roto Company, The.....144
R-S Products Corp. 136

Sarco Company, Inc. ..... *
Scovill Mfg. Co. 28-29
Shell Oil Co., Inc. 117
Simplex Valve & Meter Co. ..... *
Skinner Engine Co. 149
Smooth-On Mfg. Co. 163
Socony-Vacuum Oil Co., Inc. 15
Springfield Boiler Co. 39
Squires Co., The C. E. 170
Standard Oil Co. (Indiana).....35-36
Staynew Filter Corp. ..... *
Stephens-Adamson Mfg. Co. ..... *
Strong, Carlisle & Hammond Co. ...167
Superior Railway Products Corp.....168
Sun Oil Company.....101
Swartwout Co., The.....148
Syntron Company ..... *

Taylor & Co., W. A. 152
Taylor Forge & Pipe Works.....114
Terry Steam Turbine Co. 12-13
Texas Co., The..... 4
Tide Water Associated Oil Co. .... *
Todd Combustion Equipment, Inc... 9
Trill Indicator Co. ..... *
Troy Engine & Machine Co. 153
Tube-Turns, Inc. 103

United States Rubber Co. 37

Vogt Machine Co., Inc., Henry.....112

Warren Steam Pump Co., Inc. 122
Water Treatment Co. of America... *
Watson-Stillman Co., The..... *
Westinghouse Elec. & Mfg. Co. .... *
Wickes Boiler Co., The..... *
Williams Gauge Co., The.....168
Williams Valve Co., The D. T. 167
Wilson, Inc., Thos. C. 107
Wing Mfg. Co., L. J. 129, 147
Worthington Pump & Machy. Corp.. 33

X-Zit Sales Corp. ..... *

Yarnall-Waring Co. 10-11, 48, 154

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Firms whose advertising is not in this issue but is appearing in other issues are marked with an *

STAYS IN THERE PITCHIN' LONG PAST "RETIREMENT AGE"

CHAPMAN'S LIST 960

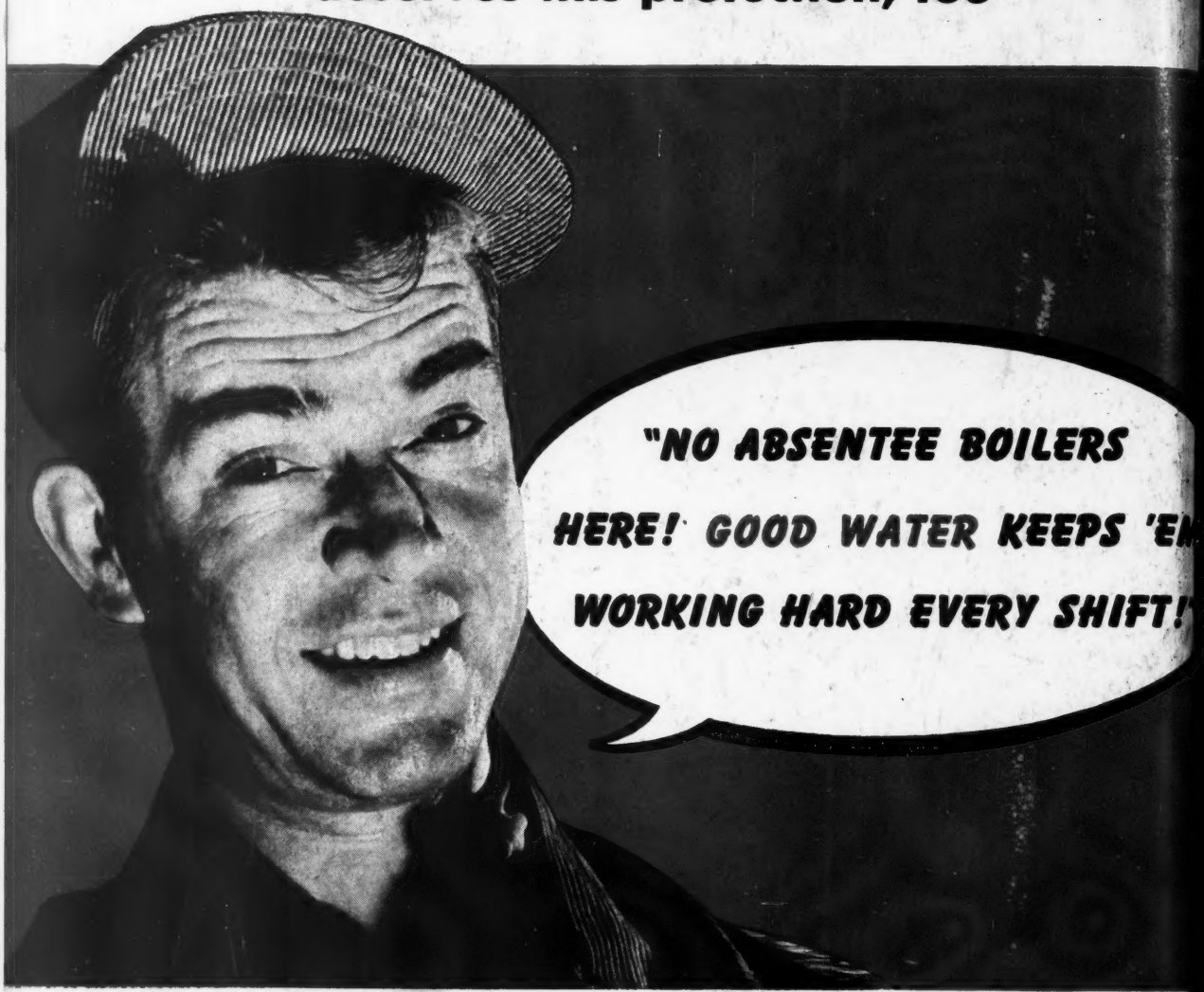
Small Steel Gate Valve

List 960 has plenty on the ball to make it outlast any similar type of small valve Tough plugs and seats hold wear hitless for long periods . . . while for extra-severe service they can be specially superhardened by an exclusive Chapman process. And even when wear finally gets in its innings, these parts can be readily replaced.

Other old familiar small-valve troubles are struck out by List 960's quick-acting threads which won't stick, strip, or jam the works. And since pressure is not transmitted to the valve-stem, the valve can be repacked under full pressure in the open position. This forged-steel valve is made in sizes from ½" to 2½" . . . good for water, steam, gas and oil.

The CHAPMAN VALVE
Manufacturing Company
INDIAN ORCHARD, MASSACHUSETTS

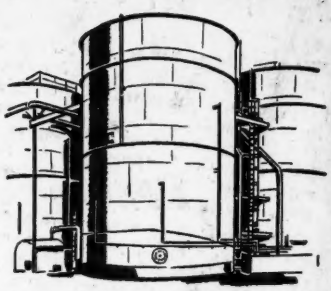
The war job you are doing deserves this protection, too



Heavy war loads bring extra dangers of shutdowns to repair boilers, auxiliaries and steam lines damaged by impurities in the feedwater. But not at Permutit*-equipped plants. Permutit water conditioning puts control of water quality squarely in the hands of plant engineers. Results are summed up by this report from a plant which recently went on 24-hour operation: "Since installing Permutit three years ago, we have found *no scale or corrosion* in our boilers."

Permutit makes every type of water conditioning equipment. Processes developed during 30 years of pioneering include Zeo-Karb*, hot lime soda softeners, deaerating heaters, the new Demineralizing Process, silica removal and continuous blowoff equipment.

Good water by Permutit is helping to insure continued production at thousands of war plants. *Your* war job needs this support, too. Write us about your problem: The Permutit Co., Dept. A1, 330 West 42nd St., New York, N. Y. In Canada: Permutit Co. of Canada, Ltd.... Montreal... Toronto... Winnipeg... Calgary. *Trademarks Reg. U. S. Pat. Off.



PERMUTIT SILICA REMOVAL PROCESS

reduces silica content to any degree desired, eliminates scale and deposits. Reagents used are low in cost and do not add soluble by-products. It's adaptable to hot or cold lime soda treatment or to Permutit's Demineralizing Process, and can be applied to existing equipment.

PERMUTIT

WATER CONDITIONING HEADQUARTERS

SERVING INDUSTRY AND THE ARMED FORCES . . . WITH

GOOD WATER